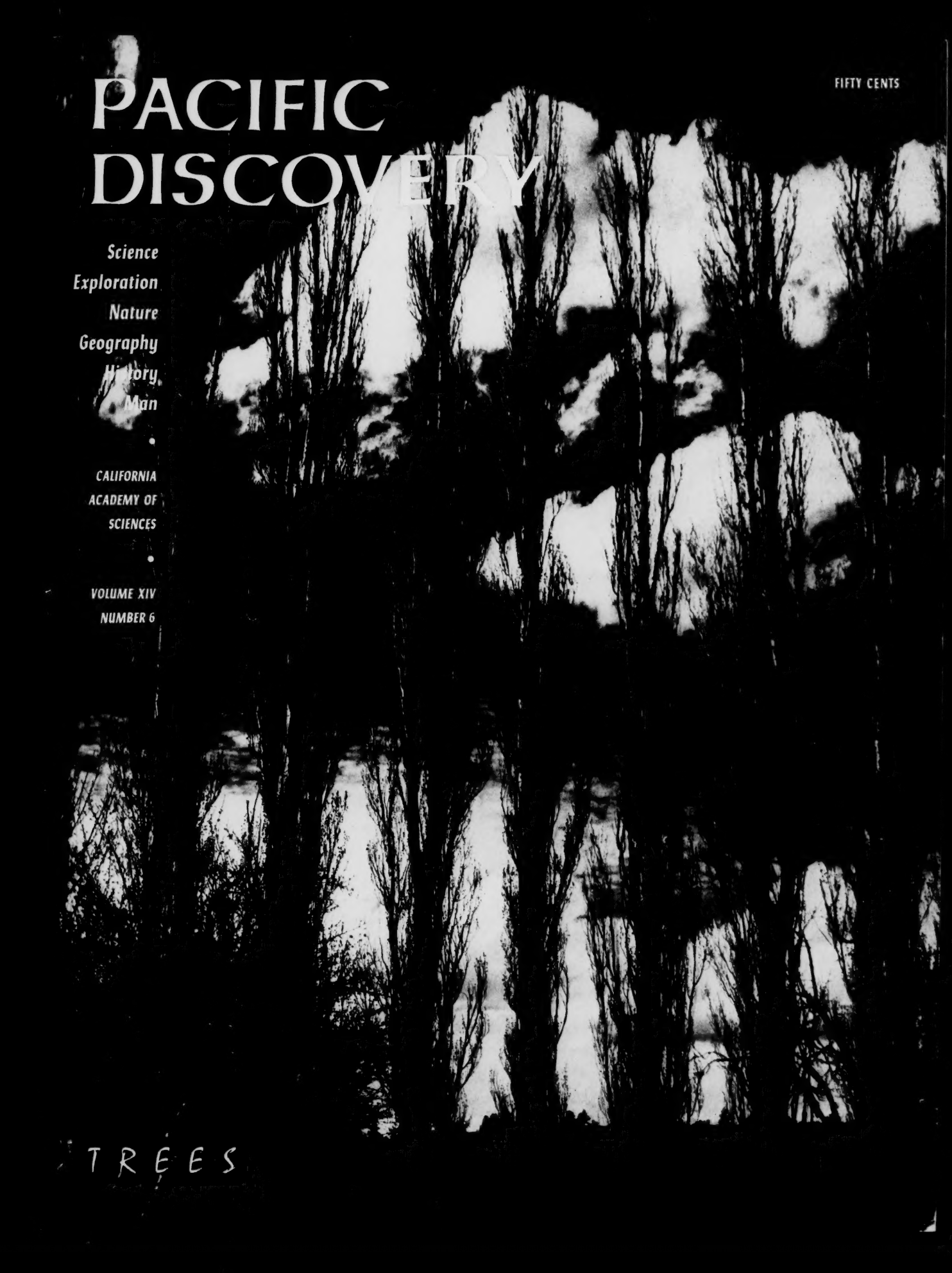
PACIFIC DISCOVERY

FIFTY CENTS

Science
Exploration
Nature
Geography
History
Man

CALIFORNIA ACADEMY OF SCIENCES

VOLUME XIV
NUMBER 6



NOVEMBER-DECEMBER 1961
VOLUME XIV · NUMBER 6

PACIFIC DISCOVERY

Editor & Art Director: DON GREAME KELLEY; *Managing Editor:* ROBERT C. MILLER; *Associate Editors:* IRA L. WIGGINS *(Stanford University)*, A. STARKER LEOPOLD *(University of California)*, JOEL W. HEDGPETH *(University of the Pacific)*, VERONICA J. SEXTON, BENJAMIN DRAPER, ROBERT T. ORR, HAL RICHARDSON, ALLYN G. SMITH *(California Academy of Sciences)*; *Nature Editor:* ARTHUR C. SMITH *(Alameda State College)*; *Special Correspondents:* THANE RINEY *(Southern Rhodesia)*, GRAHAM TURBOTT *(Canterbury Museum, Christchurch, New Zealand)*

PRE-DISCOVERY

FOURTEEN YEARS, Volume I, Number 1, to Volume XIV, Number 6, *Pacific Discovery* has been the all-absorbing occupation and challenge of your editor who now, with mixed emotions, strikes his colors from the masthead and transfers to another command. In first-person singular, which better fits the mood, I would like to say a few words—to my successor, not yet named, but first to all those who have made *Pacific Discovery* a reality instead of only an idea (*only*, because it's still, and I hope always will be, an exciting idea, to grow on). I'm thinking of all my fellow staff members of the California Academy of Sciences as well as its many loyal supporters; of editorial associates outside the Academy walls; of all you Members of the Academy and *PD* subscribers, whose numbers are increasing steadily year by year; of the devoted friends and unexcelled craftsmen of Gillick Printing, Inc. and California Art and Engraving Company who, to a man (and woman!) have considered nothing less than perfection the aim of everyday work, and who have invariably given quality beyond the price scale; of authors and photographers and artists who have enabled us to maintain an editorial standard out of all proportion to their slight reward; of everyone who has taken the trouble to offer kindly criticism, fresh ideas, or generous words of praise for the editorial effort, all of which have been helpful, and welcome encouragement, in the face of sometimes difficult and disheartening problems—to all of you and to any others I may at this moment have failed to include (such as the silent editor, my wife, who has borne the brunt of many things, and sat up nights with me at press time every October typing index cards, without pay), my heartfelt thanks. Far more goes into a thing like this than appears in black and white, and the editor, when an occasion arises to take credit for a good job, is standing in for many persons.

All of this sustaining coöperation it takes to produce a magazine will be, I am sure, the continuing lot of *PD's* next editor (only *his* wife will have to help him with the index!). I wish him good luck, and I hope it may be his good fortune to guide *Pacific Discovery* to even higher levels of merit for the enlightenment and pleasure of a far greater host of readers. May it be his lot (and this is a fervent prayer for today) to guide it into a future where more and more people will turn eves outward to mountains and meadows and wild waters and clean winds, and upward to pure skies—not dog-down into holes where the future is being put on close-out sale.

PD'S AUTHORS

ON THE BEAUTIFUL CAMPUS of the University of Western Australia, Nedlands, close to Perth, four and a half years ago, *PD's* editor discussed with **V. L. Serventy** and his brother, D. L. Serventy, some ideas for future articles on the field work of these two eminent Australian biologists. It is very gratifying to present now the first fruit of that meeting on the shores of the Indian Ocean; it is our hope that more will follow. . . . ¶ When our good friend **Reverend Samuel A. Wright, Jr.** submitted his preliminary report on a long-term bristlecone pine research project he was minister of the Unitarian-Universalist Church of Marin. He has become, as we go to press, Director of In-Service Education, Starr King School for the Ministry, Berkeley, and has moved from Marin's Terra Linda to the collegiate city. His earlier call was to science; he is a graduate in biology and sometime instructor at the University of New Mexico. . . . ¶ Trees are a *leit-motif* of this issue, it seems. Portland, Oregon's veteran naturalist with camera, **Henry H. Sheldon,** set the theme. . . . ¶ At home in Colonia, New Jersey, **Joseph L. Parkhurst, Jr.** scans history's pages for intriguing bits and pieces relating to science and exploration. . . . ¶ **Dr. Arthur C. Smith** teaches biology teachers at Alameda State College, Hayward, California. . . . ¶ Morrison Planetarium lecturer **O. Richard Norton** is also assistant curator of astronomy, California Academy of Sciences. D.G.K.

Copyright 1961 by California Academy of Sciences

IN THIS ISSUE

EDITORIAL: *More Recruits for Conservation* 1
The Great Victoria Desert V. L. SERVENTY 2
Living Monuments SAMUEL A. WRIGHT, JR. 12
Trees. Photographs by HENRY H. SHELDON 17
The Cruise of the Hassler JOSEPH L. PARKHURST, JR. 22
A Welcome to Agassiz—San Francisco: September 1872 Verse by R. E. C. S. 23
Academy of Science. Professor Agassiz Makes a Speech. SAN FRANCISCO CHRONICLE 25
FOCUS ON NATURE with ARTHUR C. SMITH 26
ASTRONOMY: *Pluto—The Planet Beyond* O. RICHARD NORTON 28
REVIEWS 31
INDEX TO VOLUME XIV 35
Academically Speaking 37

THE COVER

FAMILIAR to the open landscapes of our West, of Australia, of New Zealand, a row of Lombardy poplars to break the sweeping wind is sign of ranch or farm—ecological niche for man and his domestic animals. (More of Henry H. Sheldon's trees, pages 17–21.)

Pacific Discovery is published bimonthly at Gillick Printing, Inc. by the California Academy of Sciences. Publication office: 2057 Center St., Berkeley 4. Editorial, Advertising and Circulation offices (to which *all* correspondence should be addressed): Golden Gate Park, San Francisco 18. Annual subscriptions: U.S., $3; Foreign, $3.75. Single copies, 50c. Members of the Academy subscribe through their dues. Entered as second-class matter, February 17, 1948, at the Post Office, Berkeley 4, Calif., under the act of August 24, 1912.

EDITORIAL

MORE RECRUITS FOR CONSERVATION

THE GROWTH OF POPULATION in the last half century, presenting an ever-increasing strain on our limited outdoor recreational areas and our dwindling natural resources, has brought disheartenment to many conservationists, and some have given way to counsels of despair. As a single example, a dozen years ago a leading fisheries biologist said to me, "Our salmon resource is gone. There is no hope of saving it." But now, these twelve years later, the salmon resource is still here and there *is* hope of saving it.

The conservation picture is not all dark, but rather a chiaroscuro with areas of light and shade. Without forgetting the darkest areas that still need considerable brightening, it is well at times to look at the whole picture, and to note that there are bright areas of real accomplishment. Conservationists lose much of their effectiveness if they dwell perpetually in a "valle ombroso" and are perennial prophets of gloom.

The conservation movement has in fact made tremendous strides in the last fifty years. The annual meeting of the California Conservation Council at the California Academy of Sciences, October 26–28, pointed this up. There has been a widespread growth of the *concept* of conservation; a man may be for it—or just possibly, against it—but he knows what it means. Along with this there has been a growing consciousness on the part of the average citizen that conservation of natural resources—of woods and water and soil and wildlife—or recreational and scenic areas—all of this means something to *him*.

Resources for Tranquillity . . .

". . . It is imperative to maintain portions of the wilderness untouched, so that a tree will rot where it falls, a waterfall will pour its curve without generating electricity, a trumpeter swan may float on uncontaminated water—and moderns may at least see what their ancestors knew in their nerves and blood."

—BERNARD DE VOTO

(Quoted in *The Nature Conservancy News*, Vol. 11, No. 3)

The shift of population from rural to urban areas—a shift that has proceeded steadily and with increasing rapidity in the last fifty years—has had an effect that is difficult to assess. There seems to be a general notion that people who live in the country have a spontaneous feeling for the out-of-doors and a love of the land. But this is not necessarily true. It would be hard to show that—at a period when the rural population exceeded the urban population—the average farmer knew or cared about conservation practices, or that—apart from the fact of ownership, which provides strong psychological ties—he loved the land any more than a worker loves his factory. Farming was a way of making a living—and the migration to the cities proves that it was a hard way.

There were farmers, it is true, who did love the land, who cherished it, and who regarded agriculture as a solid and happy way of life. But these were in a minority. The average is probably epitomized by the farmer who was approached by a college student trying to earn his way through college by a summer stint of selling books on agriculture. The farmer listened patiently to the sales pitch and then replied, "Son, those books wouldn't be a bit of good to me. I'm not farming as well now as I know how."

In contrast, today's farmer is likely to be a graduate of a college of agriculture, actually an urbanized person who happens to live a few miles out of town. The farmer who sits on a fence chewing a straw while offering philosophical observations is gone, along with "the barefoot boy who drives the cattle home." I grew up in the environment described in the preceding sentence—in fact I drove the cattle home in my bare feet along a dusty road. But a way of life that has gone cannot be recaptured by any amount of nostalgia.

Indeed, I am not even sure it was a good way of life. It was a rugged life and a hard life, and maybe good for the character. But it devastated our watersheds, plowed up our prairies, created a dust-bowl, and washed millions of tons of good earth into the sea. In those days, if anything was conserved, it was because nobody wanted it. I frankly think we are doing better today.

Now about those residents of the cities, who are supposed to have lost their contact with reality. It is my observation that city-dwellers are just as keen about outdoor life and the beauty of mountain, forest and seashore as anybody in the world. They take to it with something like an atavistic instinct.

A few years ago I traveled east from Seattle on a train and had as a seat-mate a man from a large eastern metropolis—born and raised in that city, and educated in its mores. When we were passing a Montana mountain stream in the evening with the full moon reflected from it, we both walked out into the vestibule of the car to get a better view. Suddenly my companion spoke up: "Gee, look at the moon in that water; it shines like an electric light."

Now this is probably just about the ultimate opposite of any way in which I might have expressed myself. But I knew what he meant. He responded to the beauty of the scene, and was expressing himself in his own terms. I think he was just as emotionally involved as I.

When I speak of more recruits for conservation, I mean drawing in these people—not committed conservationists at the moment—who respond to Nature and to natural beauty when they see it, and who will want to preserve it forever. R.C.M.

V. L. Serventy

THE "DESERT" *means many things. To some the word conjures up a place of death and desolation, of strong winds and drifting sands, where no plants grow. To others it is a place of romance made familiar by films from Hollywood. To the scientist it can mean a place where there are no months of effective rainfall. A convenient measure of effective rainfall has been devised by geographers. The fraction of rainfall over evaporation, when more than one third, is said to be effective; when less than one third, it becomes useless for plant growth. Very few places in Australia show effective rainfall over the whole year; they add up to about nine per cent of the continent. About one third of Australia has no months of effective rainfall at any time of the year. Here lie the true deserts. On their fringes sheep and cattle can be pastured but agriculture is risky. Too often, high hopes end in despair in these debatable regions. Yet at times the desert can turn a smiling face to the traveler. An average rainfall is only a fiction, a product of the weather bureau. Five inches of annual rainfall might mean 15 inches in one month and then no rain for the next few years. So it is this area of extremes, of rare downpours and regular droughts, of flush times and times of scarcity, that constitutes a desert.*

Crossi
we he
a Jee

THE GREAT VICTOR

THE GREAT VICTORIA is one of Australia's most famous deserts. Lying in Western Australia, it is a desert hemmed in by deserts. To the west is the arid country around Kalgoorlie; to the north lies the Great Sandy Desert; to the south the Nullarbor Plain; and to the east the stony desert of the gibber plains.

It was this almost unknown land we visited. Blanks on a map have a fascination, and the Great Victoria Desert has remained almost unknown since the explorer Ernest Giles first discovered it in 1875. From Boundary Dam on the South Australian border Giles traveled 323 waterless miles until, near disaster, he stumbled across Queen Victoria Spring. This is what he called it:

". . . The most singularly placed water I have ever seen, lying in a small hollow in the centre of a little grassy flat, and surrounded by clumps of the funereal pines, 'in a desert inaccessible, under the shade of melancholy boughs.'" Giles' journal describes the situation of the "no doubt permanent" water in detail, giving thanks "for the discovery of this only and lonely watered spot, after traversing such a desert."*

* See *Australian Explorers: A Selection from their Writings with an Introduction*, by Kathleen Fitzpatrick, London: Oxford University Press, 1958, page 487.—Ed.

On the western edge of the Great Victoria Desert a mission has been established at Cundeelee. The superintendent of this mission, Mr. Bob Stewart, has made several "mercy expeditions" to the east to meet the desert aborigines. He offered me the opportunity to travel with him on his most recent expedition. Quickly I organized a small scientific party. With my brother Dr. D. L. Serventy, Dr. A. R. Main, and the naturalist, Mr. W. H. Butler, we made our rendezvous at Cundeelee. With us as guides went Ben and Laurie, two aborigines who a few years ago lived in the desert. In case of trouble it was their job to get us safely back to civilization. Only the expert can find food and water in the desert. Laurie and Ben had learned that skill by the sufferings of thousands of years of forebears who had not mastered the desert but learned to live with it.

The first day's run was pleasant, driving through mallee and bluebush. Birds flew before the Landrover in excitement at this invasion of their privacy. Ringneck parrots peered from nesting hollows. Galahs rose screeching from waterholes. Zebra finches drank daintily and flew off to the protection of prickly acacias. Near Naretha, a hardy Yugoslav community burns the limestone of the Nullarbor into quicklime

Crossing the Nullarbor Plain we head into the desert with a Jeep and two Landrovers.

ORIA DESERT

Galahs at a waterhole.

Young wild turkey.

Lime kiln at Naretha, on the Nullarbor line.

An emu chick.

The Nullarbor line, Western Australia and South Australia.

for the mines of Kalgoorlie. The raw material of lime is plentiful enough but trees are scarce.

The roadsides were gay with flowers. Bobtail skink lizards scuttled out of our way. Soon the trees disappeared except for small patches in "dongas," depressions in the limestone where enough soil had gathered to carry a pocket of shrubs, trees, and rabbits. The most attractive of these trees was the desert Pittosporum.

Mile after mile we drove through treeless plains until north of Loongana we turned towards the Great

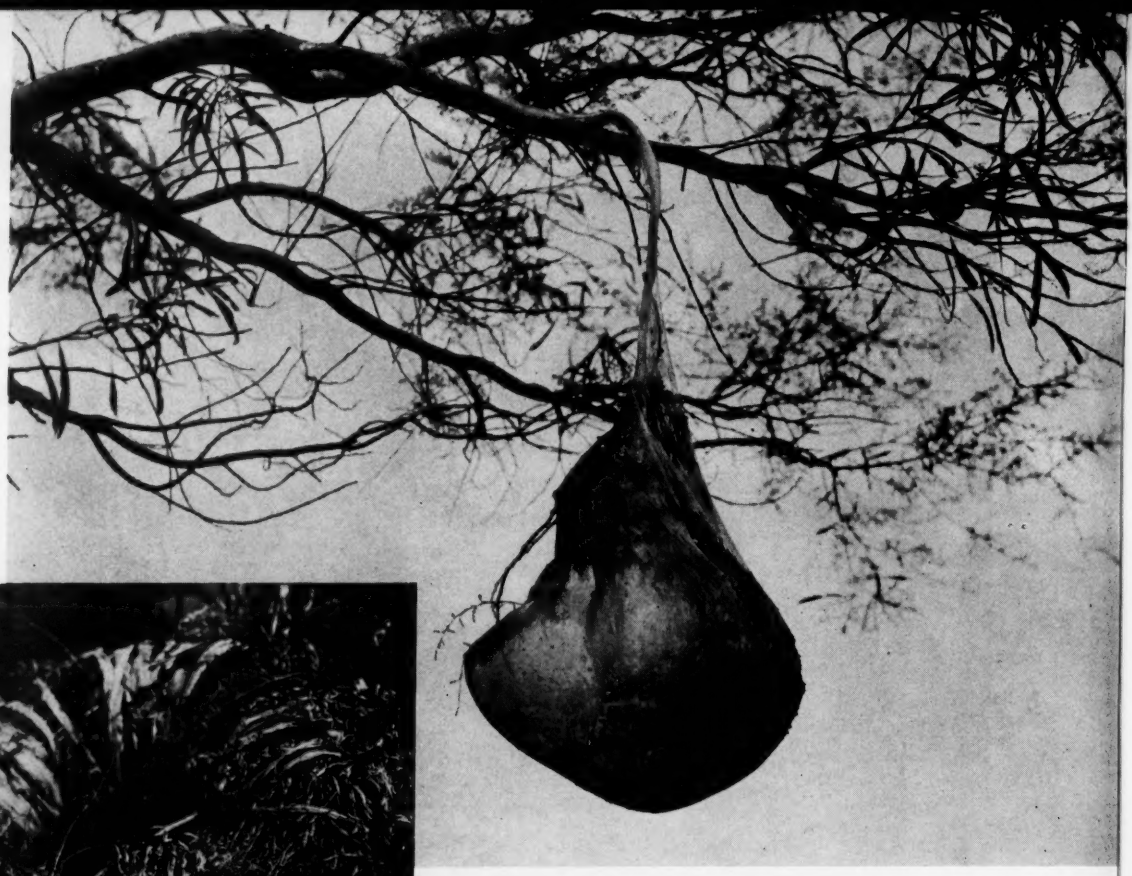
A donga, depression on the Nullarbor, gay with flowers.

Victoria Desert. A grim sign warned that only well-fitted expeditions should go farther.

Camp for the night was made in bluebush country. A chestnut-tailed thornbill nesting nearby scolded us vigorously. Processionary caterpillars marched busily in search of a patch of soil in which to dig and pupate. We made our base camp at the Station. This old abandoned property was never stocked, except for a few camels. Rumor had it that the lure was a golden churinga hidden in the region. A *churinga* is a sacred object of the aborigines, usually of wood but often of stone. It would not be impossible for a gold nugget to have been found and worked into a churinga by these people of the desert.

At the Station we left our spare petrol and water. Geological treasure awaited us a few miles farther on. Here boulders tumbled down a hillside in a confusion of types. Dr. Main identified these as glacial till. Further discoveries during the journey extended our knowledge of the rocks of the area and, now, what was once a large white blank over hundreds of miles is known to be of Permian age. Already an oil exploration party has followed the trail we blazed, to examine the rock outcrops.

On a claypan we found a dam of the aborigines. Wheat-belt farmers use the same technique to con-



Bag shelter of the processionary caterpillars.

The ceremonial wreath in a wattle tree.

Sturt pea, named after one of Australia's great desert explorers.

serve water in dry areas. Nearby, deserted huts gay with Sturt pea showed this had been an important camping place. By nightfall we made camp at Eeldoon. The waterhole was marked with boulders to show that all could drink at the hole. In some places waterholes were sacred—women and uninitiated boys had to go thirsty. Two stones nearby showed the old men's place, taboo to others. Three hundred yards away a ceremonial wreath rested in a wattle tree, but the people who had marked the waterhole, obeyed the warning of the stones, and made the wreath, lived here no longer. Willy wagtails and galahs drank the waters of Eeldoon.

We were now in the heart of the desert country. For hundreds of miles sandhills thirty feet high lined the desert. Marching in orderly rows, with their lengths running east and west, they barred our progress. Between the dunes porcupine grass and tall barra gums gave a parklike aspect. To go north or south meant crossing the dunes. We charged them like knights of old, vehicles snorting and roaring defiance. When we bogged near the crest it was a case of backing down and making another run, all hands pushing and shoving to get the car over the crest. It was a time the passengers will not forget; at least the driver could hold the wheel.

Every day, radio calls went out to Cundeelee in case of trouble. Previous expeditions had run into difficulties. Clutch, differential, tires—the desert sandhills strained them all. It was now a matter of hours per mile, not miles per hour.

Thirty-six sandhills after the first one, we straggled into Boorabbie. Here a sign told the story of previous Mission expeditions. Only a handful of white men had ever gone beyond this point. The waterhole was almost dry but many signs of the desert people could be found. An old grinding stone lay abandoned on

Grindstone left in the desert by the People.

Dry waterhole at Junegulla.

Our desert guides, Ben and Laurie, with the sacred boards left behind when the People went away from Junegulla.

Marker for the stone arrangements area, at Boo-yoo-noo.

the sand. Crested pigeons whistled through the air as they came to drink the scant water. Galahs flew screeching past, and zebra finches drank and moved on.

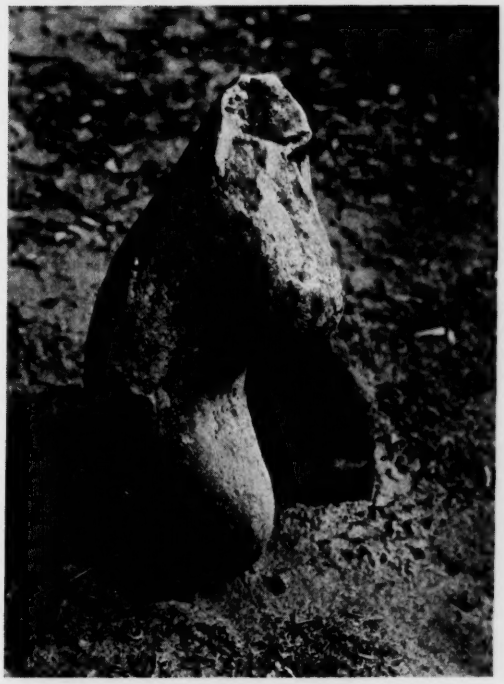
Beyond Boorabbie lay Boo-yoo-noo. Here to the famous ceremonial grounds came the People. Every four years they came for the increase rites, the man-making ceremonies – the ritual so necessary to

strengthen the tribe. Now most of the people were at Cundeelee. Perhaps thirty or forty still remain in the desert. Ben and Laurie had been making smoke signals in a vain attempt to make contact with their people. Boo-yoo-noo was the last hope.

At Junegulla the sacred boards were kept. In reverent silence Ben and Laurie broke branches from mulga and laid them on the ground. On top of these they placed the boards. It was a dramatic moment. Then just as reverently the boards were placed back in the mulga tree, and the branches also, as they had become sacred through contact. It was a pause in our journey we will long remember.

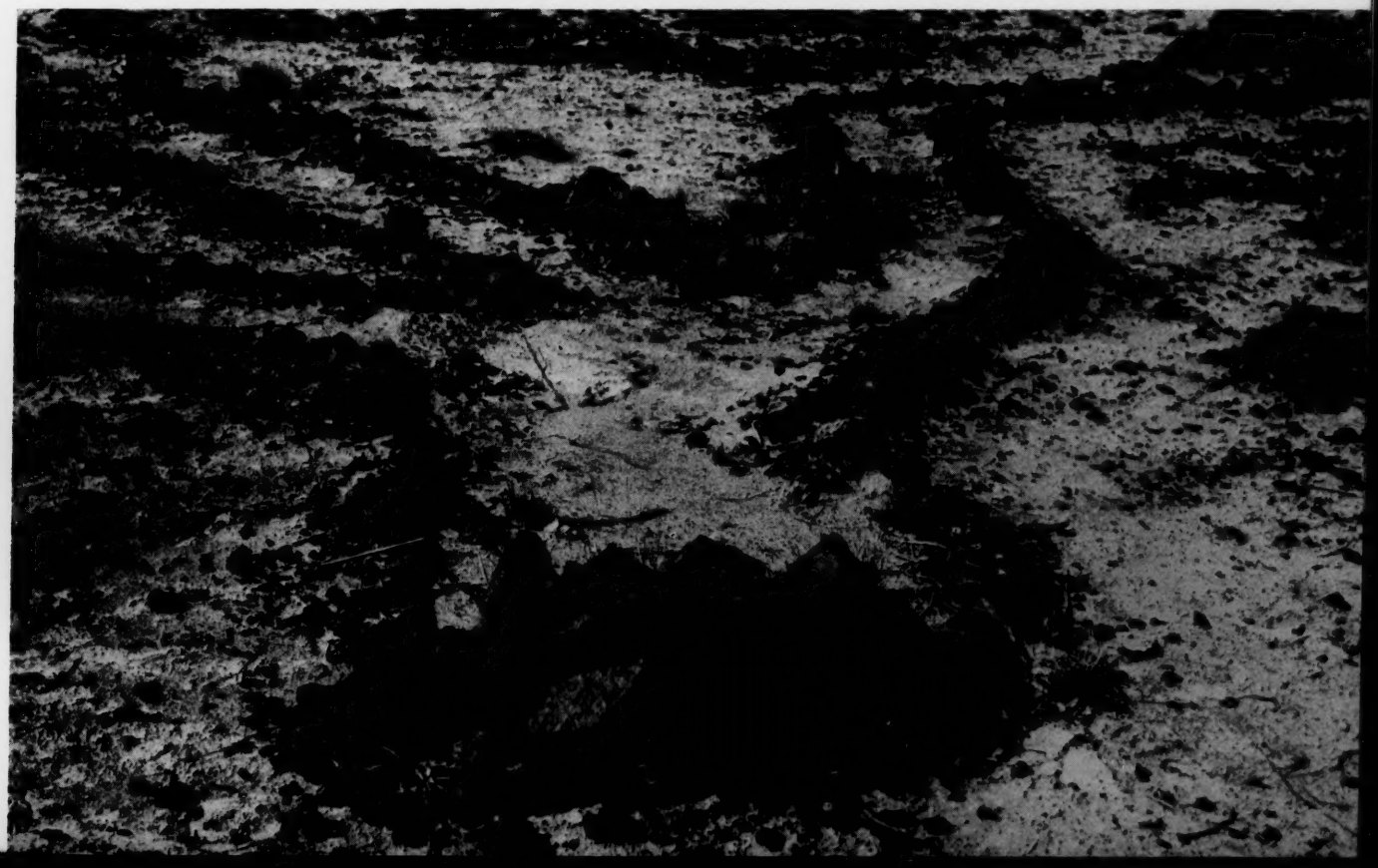
Again we went through desert sandhills gay with flowers, and rested to watch a mountain devil feeding. Then on to Boo-yoo-noo we drove, to find the waterhole dry and the camp deserted. The stone arrangements glittered in the hot sun. The initiation pit was unused. In the mulga flat a sacred stone kangaroo emblem remained untouched. There was sadness in the late afternoon as we returned to the truck. Here we were to leave Ben and Laurie. They were to stay in the desert to search for the People. Beyond this point our vehicles could not travel. On foot the two men would continue the search. If they had not returned in eight months' time, once more a Mission truck would come back to Boorabbie to get them.

More leisurely we retraced our outward track, collecting specimens. We found a rare scarlet-chested parrot. We sectioned desert pines, hoping, later, to

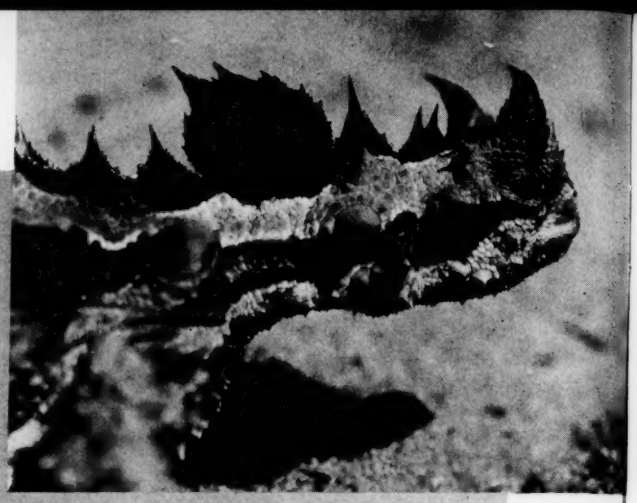


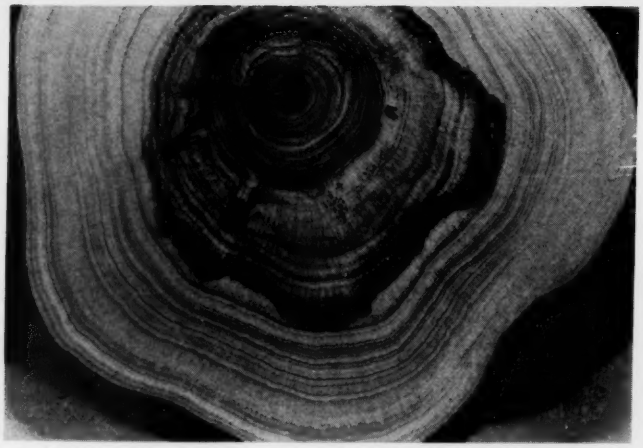
The sacred stone kangaroo, still standing at Boo-yoo-noo.

The pit that was used for initiation of the young men, at Boo-yoo-noo.



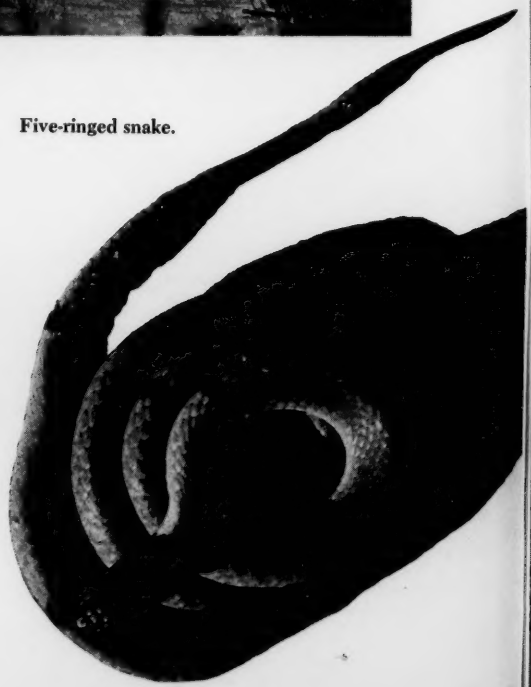
Mountain devil *(Moloch horridus)*, a strange dragon-like lizard, which feeds only on ants.





A section of desert pine, its rings telling a story of climate. (Photo by A. R. Main)

Five-ringed snake.



learn the climatic history of the desert from an examination of growth rings. Man-made records go back only seventy years; the pines may witness more than three centuries. Hopping mice, trapdoor spiders, geckoes, frogs, snakes, plants—all was treasure that fell to our eager hands.

Back at Cundeelee we decided to visit Queen Victoria Spring. Through a roadway flanked by giant grass trees standing like heraldic spearmen, we saw the spring with its slopes clothed in golden everlastings. Nearby was a monument to one of the earlier expeditions. A carved tree had decayed and so the inscription had been set in concrete in an attempt to save it. A gray teal fell to our guns and we cooked it native fashion wrapped in mud and baked in the coals.

Some years earlier at these springs I had seen tens of thousands of budgerygahs coming to water. Farther south more than half a million birds screamed around the railway dam. It was an amazing sight as the birds drank rapidly and flew off. Then among the stragglers, like thunderbolts, the hawks would fall, plucking the green parrots from the ground in one swift swoop. I have seen no place where the struggle for survival was more merciless than at this waterhole.

The full scientific results of this expedition have not yet been assessed as we are still working on our notes and collections. Yet we do know something of the geology of the area and the pattern of plant and animal life. Most interesting of all, we have proved that this Great Victoria Desert is not the barrier to living things we had imagined it to be. Rather it is a corridor along which life can move from east to west —life which is, at least, adjusted to the desert environment.

Thousands of budgerygahs at Queen Victoria Spring.

Jim Moore, KGO announcer, checks the map before taking the road from Marin County to the high bristlecone pine country.

LIVING MONUMENTS

SAMUEL A. WRIGHT, Jr.

AN AURA OF FASCINATION *surrounds any living example of the possibility of attaining extreme age, be it the "oldest living inhabitant" of a country, an animal or bird whose species is considered to have an extraordinary longevity potential, or—the supreme case—"the oldest living thing in the world." To the best of our knowledge, nothing can qualify for the ultimate honor but a tree. It may be a* Sequoia; *but science is now trying to unlock the "remembrance of things past"—especially the yearly climate patterns—coded into the annual rings of an obscure high-mountain pine. (See also "Dendrochronology: Key to the Past," by William A. Bardsley,* PD, *January-February 1958.) Where bristlecones grow, climate may vary the ring count. . . .*

Looking north from Squaw Peak in the Inyo Mountains, high among the bristlecone pines, White Mountain Peak (elevation 14,242 feet) can be seen in the distance. On its summit the University of California maintains a high altitude experiment station.

WHEN HAMMURABI, the Babylonian king who drafted the first code of laws known to history, came to the throne about 1750 B.C.E., pine trees still growing today on the high slopes of the White and Inyo mountains of California were already centuries old.

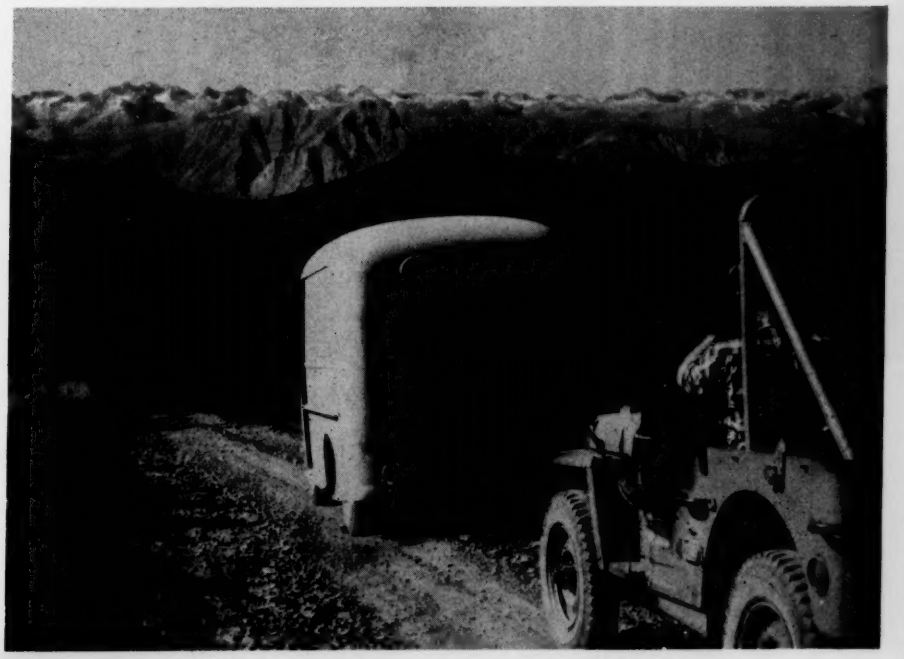
In the rocky ledges and shale of the dry, southwestern face of Squaw Peak in the Inyo Mountains, buttressed bases of trees are still gripping the rocks with claw-like roots which tell of centuries of indomitable struggle. Of the upper trunks of these trees, only sand and ice blasted heart-wood remain, carved in the knotted, spiraling patterns of wind timber.

At this 10,000-foot elevation above sea level, the younger trees also show the hardness of their life, for the invisible weapons of sand and ice scour the bark off the windward side of the trunk and branches, laying it open to the grain of the white sapwood.

Until as recently as 1956, when the late Edmund Schulman published his *Dendroclimatic Changes in Semiarid America* (University of Arizona Press), the Sequoias were considered the oldest living trees. Dr. Schulman's discovery of bristlecone pines (*Pinus aristata*) over 4,000 years old, in the White Mountains of eastern California, brought to public attention yet another gap in man's knowledge of the world around him. These pines, still bearing cones, were over a thousand years old when the oldest known Sequoia was a seedling.

Bristlecone pines were first made known to science by Dr. C. C. Parry, who discovered them on Pike's Peak in Colorado in 1861.[1] The following year he sent seeds to the Botanic Gardens of Harvard College, and it was later reported: "In the Atlantic States Pinus aristata grows very slowly, the plant raised from Dr. Parry's seeds being after thirty-five years only about two feet high."[2]

However, the earliest record of the Bristlecone pine dates from August 31, 1853, when F. Creutzfeldt, botanist with the Pacific Railway survey through



From the White Mountains, the "snowy sawtooth" profile of California's Sierra Nevada is clearly visible across Owens Valley to the west, but close as the greater range is, no bristlecone pines grow there or anywhere else west of the White and Inyo mountains.

The 21-year-old van contained bunk beds, stove, sink, water tank, and our gear—but only the Jeep could get us close to some bristlecone areas.

A western juniper marks the top of 7,271-foot Westgard Pass which divides the White Mountains to the north from the Inyo Mountains to the south. The road to Schulman Grove turns off to the left a few miles beyond these markers.

↑ The "Patriarch" is the largest known bristlecone pine, with a girth of 36 feet. Surprisingly, it is only 1,500 years old.

← This weathered giant bristlecone taped at 27.5 feet around the waistline. The age of trees is not necessarily related to their size. Some of the oldest trees were only a few feet in diameter.

Two methods of taking tree ring samples are the V-cut on a stump and a core pulled out with an increment borer. This Swedish-made instrument—hollow drill with T-handle—removes a slender cross-section through the annual growth rings along a radius to the heart without injuring a tree. The pencil of wood Jim Moore is holding witnessed more than a thousand years of incredibly slow growth.

◄ Old bristlecones do not fade away. They are literally scoured to oblivion by thousands of years of wind hurling grains of sand and crystals of ice.

Colorado, collected a single branch without cones in the Cochetopa Pass area of the Rockies. Two months later, in eastern Utah, Creutzfeldt, along with his commanding officer and others, was killed in the Gunnison Massacre. Through the intervention of Governor Brigham Young, papers and instruments were later recovered from the Indians and eventually Creutzfeldt's specimen of bristlecone pine reached Dr. Asa Gray and Dr. John Torrey, to be classified.[3]

In 1908 George B. Sudworth, in his *Forest Trees of the Pacific Slope*, said bristlecones were "reported to be on the high Sierras east of Yosemite Park and on Mount Pinos in Ventura County, but these stations require further investigation."[4] These reports were apparently in error, for the range of *Pinus aristata* Engelmann, in California, is presently believed to be limited to the Panamint, White, and Inyo mountains in the southeastern part of the state. It was on Squaw Peak in the Inyo range that we were searching for trees whose living conditions were difficult enough to provide the slow growth which has made these pines famous.

After exploring the literature on these trees and

↓ Bristlecones prefer to grow in limestone. The trees, like the white calcium carbonate rock, mark the soil change with a definite line.

From this stump the late Dr. Edmund Schulman, University of Arizona dendrochronologist, cut a living tree over 4,000 years old. A section of it is now part of a permanent tree ring exhibit in the Alice Eastwood Hall of Botany at the California Academy of Sciences [gift of the author.—EDITOR.] The reader is referred to *PD*, January-February 1958—shown here—for other bristlecone photos.

making a visit to the "Ancient Bristlecone Pine Forest," in California's White Mountains, where 28,000 acres of public land was set aside in 1958, for the preservation of the "oldest known living things," more questions than answers presented themselves to me.

To the ecologist and plant geographer, the fact that bristlecone pines are not found on the Sierra Nevada, just a few miles west across Owens Valley, yet are found above the 10,000-foot elevation from the Rockies to Telescope Peak in the Panamints above Death Valley, is a mystery yet to be solved. Geologically, the desert-like White Mountains are much older than the Sierra Nevada which pushed up to where it now dries the moist air from the west. Perhaps the forests which once covered the White Mountains retreated to the high peaks, leaving the rugged bristlecones as hardy survivors. But why are there none on the Sierra Nevada today? What limits these trees to timberline elevations? Why do they live so long? Answers to these and other questions would not only push back the frontiers of knowledge, but could open new doors to a better understanding of longlivedness in general.

In late October of last year, with such questions in mind, we drove from San Francisco over the high Sierra for a two-week survey of bristlecones. The area selected was the Inyo Mountains south of Waucoba Pass, above the towns of Big Pine and Independence, California. At Big Pine we filled our extra water and gasoline containers, for the area is isolated and the high Sierra Nevada desiccates the air before it crosses Owens Valley, and the few springs could be expected to be dry so late in the year.

According to geological survey maps, an old mine road followed the washes from Waucoba Pass to the foot of Squaw Peak and Waucoba Mountain, whose elevation was shown as 11,123 feet above sea level. It was on the dry slopes of these mountains that we hoped to find old bristlecones and discover some of their secrets.

Single-leaf piñons (*Pinus monophylla*) and western junipers (*Juniperus occidentalis*) were the only trees at our 8,000-foot camp. But on the slopes a thousand feet higher, we could see the distinctive wind and ice carved branches of bristlecones. With our borrowed Jeep, good walking legs, and an increment borer on loan from Dr. Woodbridge Metcalf of the University of California Department of Forestry, we presented man for the first time to trees which were ancient when Socrates taught in Athens.

Laboratory study of drill cores from sample representative stands of bristlecone pines from Colorado to California, by overlap matching of rings, have given a backlog of data on climatic conditions in the area for the past 4,000 years. My interests, however, were primarily in the trees themselves. Why did the relatively soft wood not rot after several thousand years of exposure? Certainly trees that live so long might tell us something of resistance to disease and parasites. Many field trips will need to be made to fill out the story of these windswept snags.

On the northern slopes, and where the shelter of canyons protect the trees from the wind, they grow luxuriant with dark shining needles completely clothing numberless branches, giving them a bottle-brush appearance. For this reason the local hunters mistakenly call them foxtail pines (*Pinus balfouriana*), which grow in the southern Sierra Nevada on the western slopes. Like the bristlecones, foxtail pines grow in the highland, scoured by ice and wind, and commonly with the top dead, and bark skinned off so the whitened skeletal branches twist toward the sky. Bristlecones, however, can never be mistaken, for no Foxtail Pine has the sharp prickles on the scale of its cone which gives the oldest living tree its name.

It is interesting that this general area of California seems to have a monopoly on aged trees. Western junipers above Tenaya Lake, in Yosemite Park, were given an age of 2,000 years, by John Muir, before the turn of the century. And not far away on the western slope of the Sierra are the oldest giant Sequoias, which date to 3,212 years. Dr. Schulman's oldest-dated living bristlecone was more than 4,600 years old.[5] The contrast is drawn when one realized that of all the trees of many species throughout the world which have been estimated to be very ancient, none other has yet been verified by careful study to be as much as 3,000 years old.

What will be learned from these rugged bristlecones will continue to unfold as more data are gathered. Already a great deal has been learned about the climate of the past. The wood of the old trees is very resinous. Maybe there is something to be learned about the chemistry of the resin which seems to preserve the relatively soft wood. And whwat is the secret of the tree's ability to hold the line in a particularly dry year and then grow vigorously in a wet one—not for a few hundred but for thousands of years? So far these trees have given more questions than answers. Years of study and many trips are still to be made to discover the rich secrets of these living monuments which stand at timberline as craggy sentinels guarding the past.

Notes on Sources:

1 Parry and Engelmann, "*Pinus aristata* Engelmann," *American Journal of Science and Arts*, Ser. 2, 34:331, 1862.

2 Sargent, Charles Sprague, Director of Harvard Arboretum, Harvard University, "The Silva of North America," *Coniferae*, Vol. XI, Peter Smith, New York, 1947.

3 Peattie, Donald Culross, *Natural History of Western Trees*, Houghton Mifflin Co., 1953.

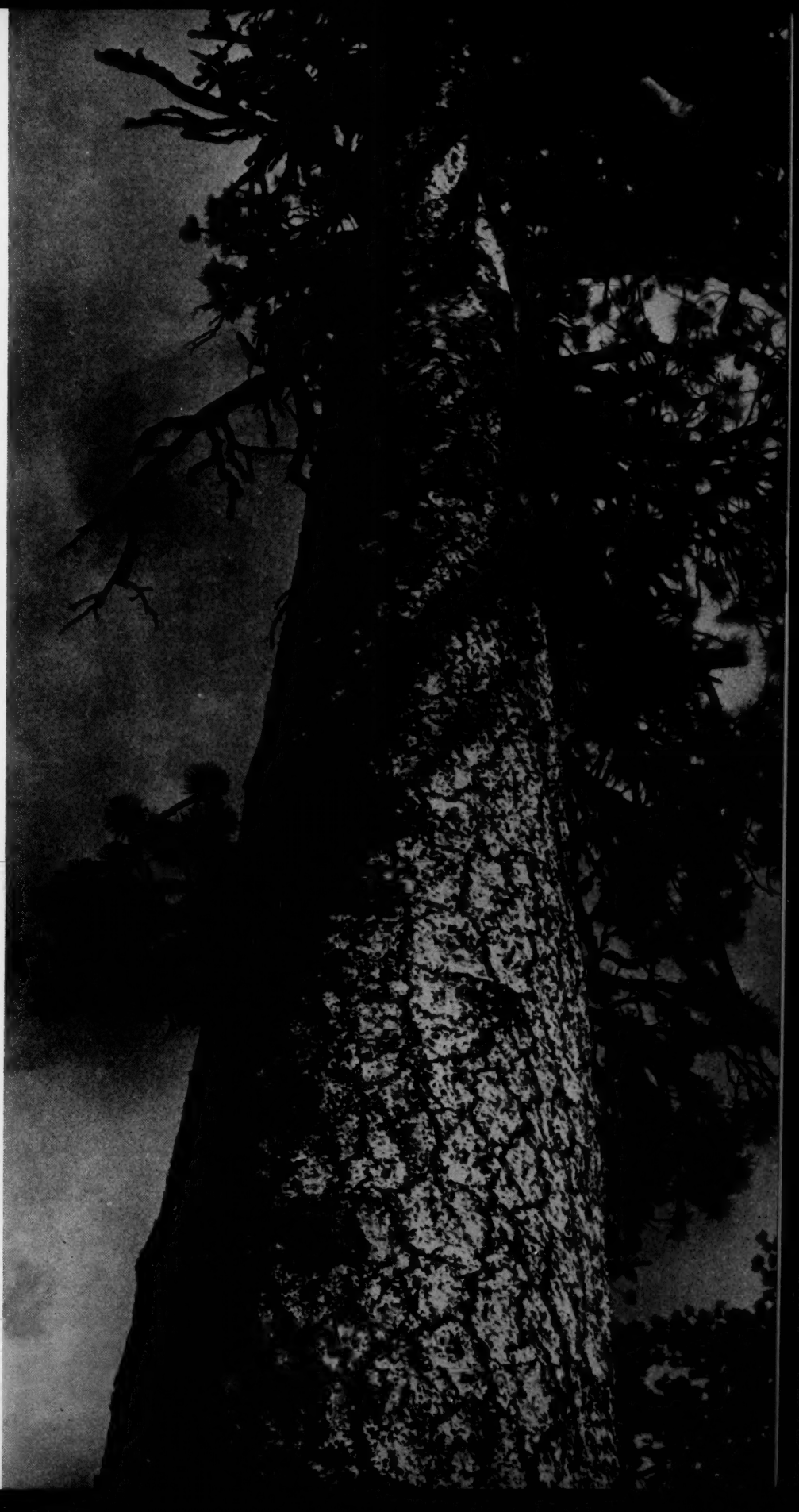
4 Sudworth, *Forest Trees of the Pacific Slope*, U.S.D.A. Forest Service, 1908, p. 39.

5 Schulman, Edmund, "Bristlecone Pine, Oldest Known Living Thing," *National Geographic Magazine*, March, 1958.

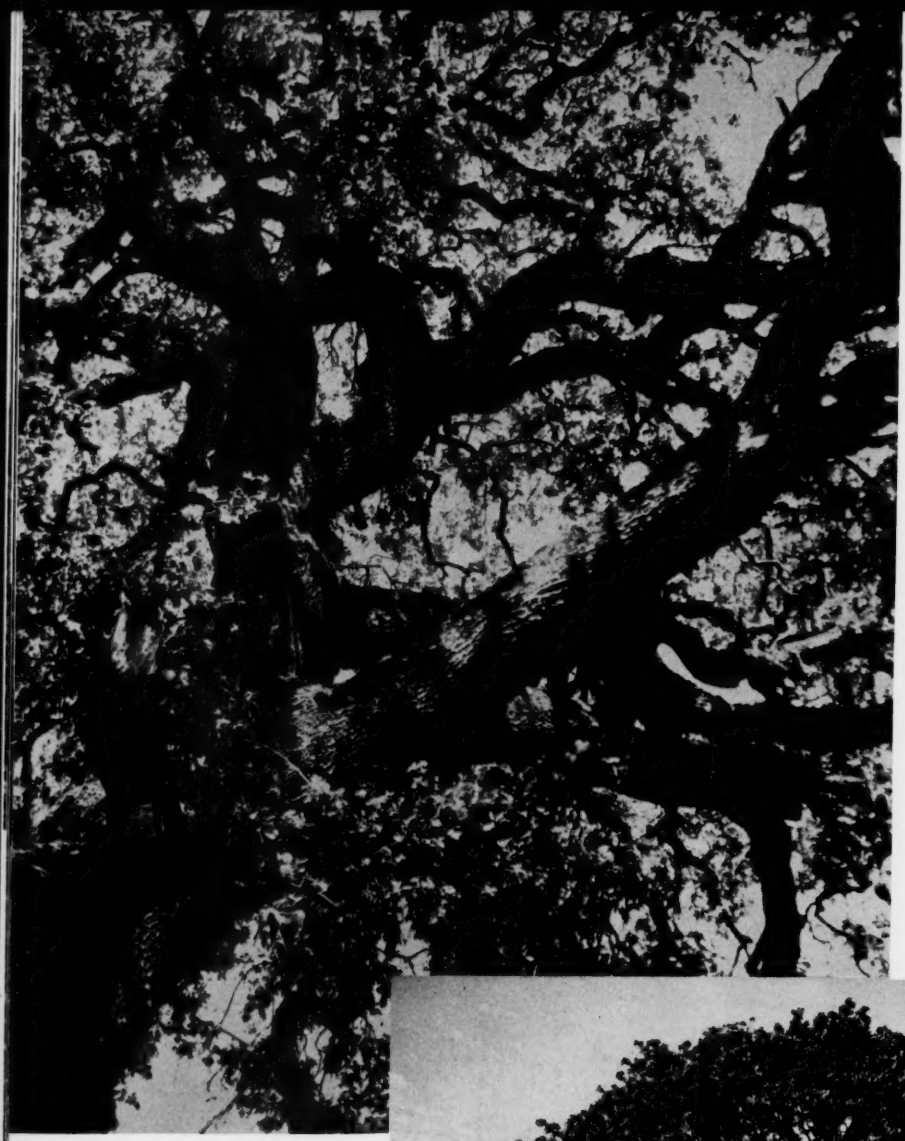
Henry H. Sheldon

TREES

Trees are among nature's indispensable gifts to the earth, one of her greatest boons to man—for his use and for his esthetic enjoyment. Without them, the land would eventually wash away into the sea and man would be infinitely poorer both economically and spiritually. Without question it behooves us to nurture, cherish, and fully appreciate trees. Cut them, use them, we must, but not without need and not without great care. There are individual trees worth knowing, just as there are individual people. And there are nobles among trees to respect and patriarchs to venerate. To know a tree well takes more than a casual look. There is always something new to learn about a tree, and especially about one that is exceedingly old.



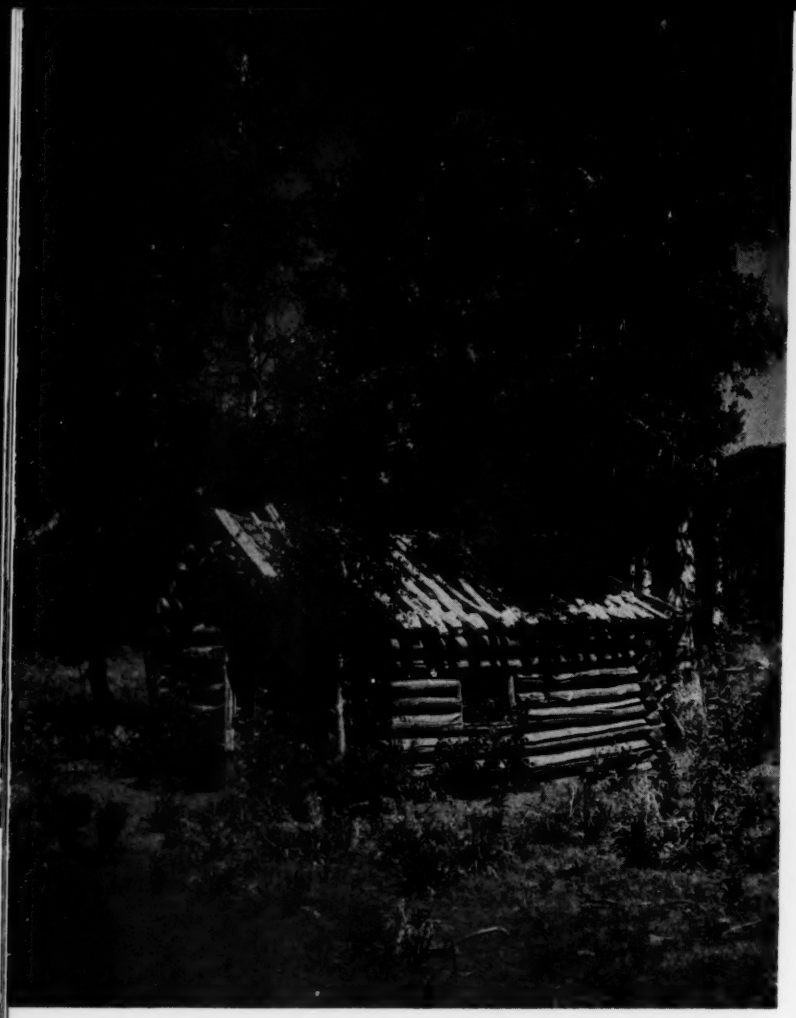
One of the fine trees of the lumber industry is the ponderosa or western yellow pine, its checkered bark pattern a familiar sight of the west's mountains from 3,000 to 8,000 feet.



These massive limbs belong to a fine example of the valley oak, *Quercus lobata*, a tree of greater esthetic than commercial value. This particular one is home to many birds, of which several species such as the Bullock's oriole nest in its long, flowing branches which hang from the crown. The inner limbs show the use and wear of many generations of stout California woodpeckers.

A dogwood tree is always a beautiful thing to see in bloom and this one—twice the average size of its kind—is beyond compare. Above a century old, it graces the town of Milwaukie, Oregon. At its time of full glory, about the first of May each year, it brings many visitors to Milwaukie; and they may note that it has been marked as a memorial to Susannah Lee Barlow, a famous Oregon pioneer.

More than a century and a half ago, when Lewis and Clark camped on Sauvies Island, now a suburb of Portland, Oregon, this bigleaf maple was well on the way to gaining the distinction of being the largest and most perfect specimen of its kind the forester Dale Christiansen has seen in all his travels. The trunk is nearly eight feet in diameter. The reach of its dozen huge limbs gives it a breadth of 100 feet, while the crown is 85 feet above the turf.

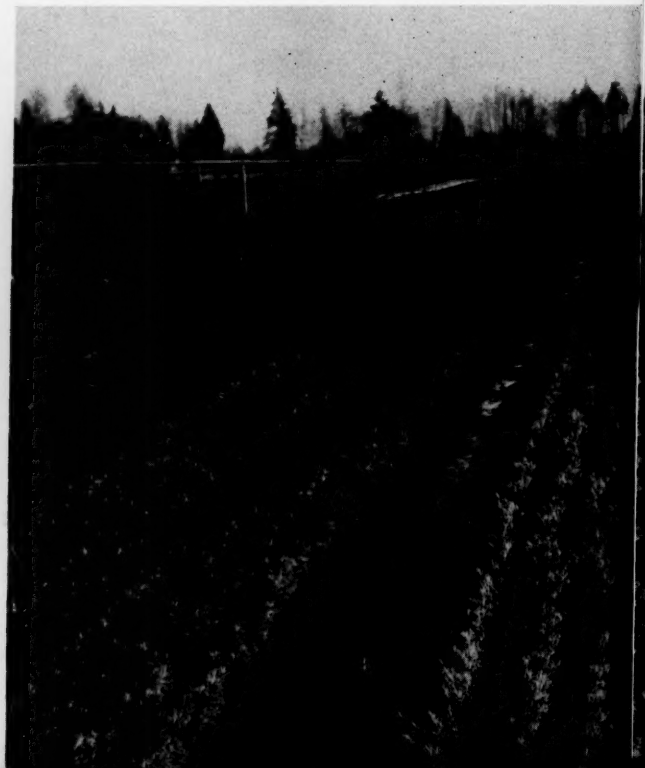


In places where trees have left mineralized remains, they give witness, sometimes, to their early leasehold; sometimes, to their ancient presence where none of their kind lives today. Arizona's Petrified Forest lies on desert ground; Yellowstone's agate trunks stand beneath living forests where the ash of Miocene volcanoes buried them. This redwood giant in stone near Calistoga, California, shows *Sequoia sempervirens* has been evolving in the same coastal region for five million years or more.

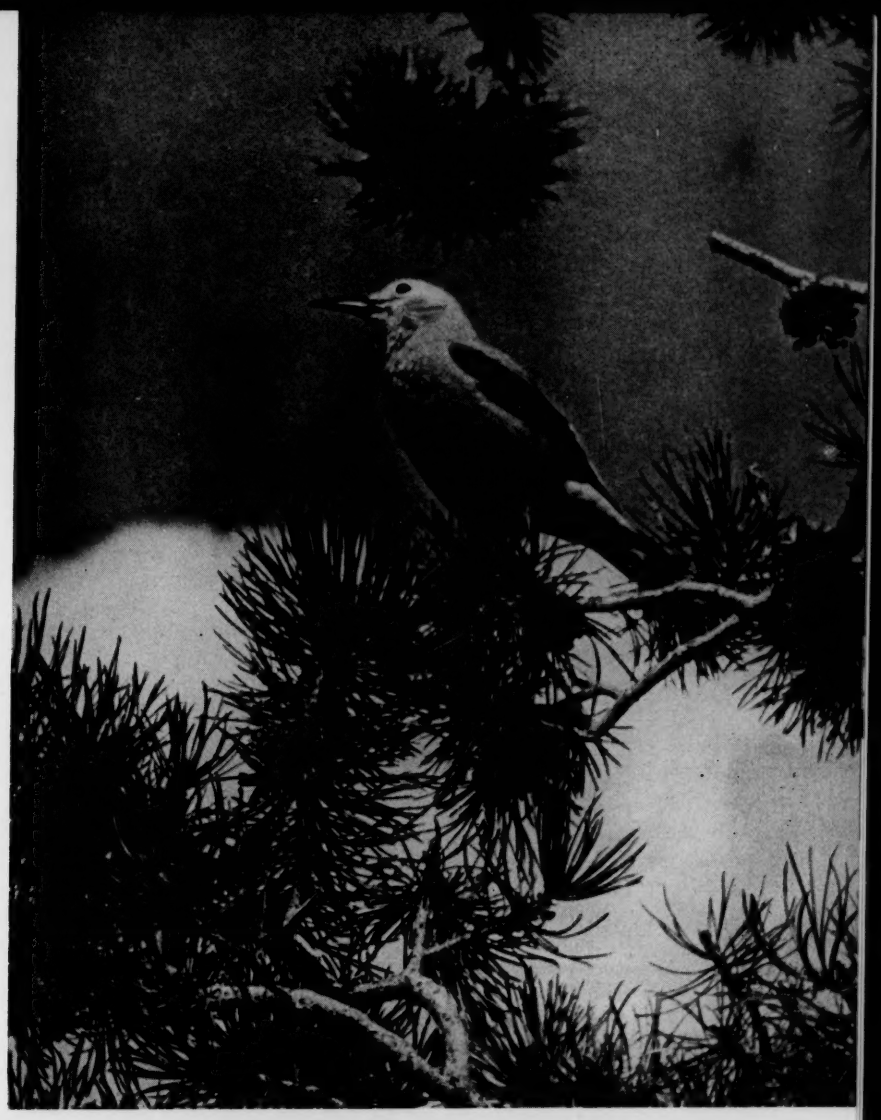
High up where the aspens grow in the Steens Mountains of southeastern Oregon, the power of the forests to reclaim its own is well demonstrated: a long deserted trapper's cabin is being relentlessly torn apart by trees that have taken root in its earthen floor.

Tree farms, like this one at Nisqually, Washington, are belated recognition of the fact that we have burned or cut our forests faster than natural propagation could replace them. More than a million trees are nurtured here from seed every year to restore some of the losses.

A sawn log washed up on a Northwest beach has its annual ring pattern etched in sharp relief by the erosive action of salt sea water and driving surf.

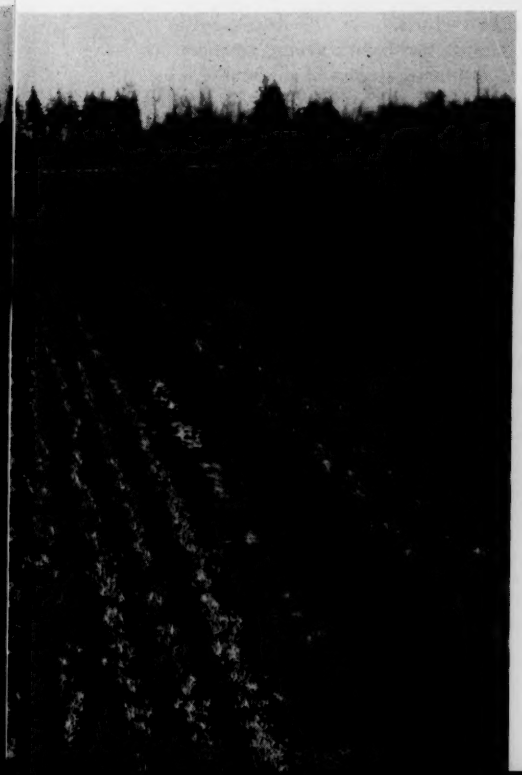


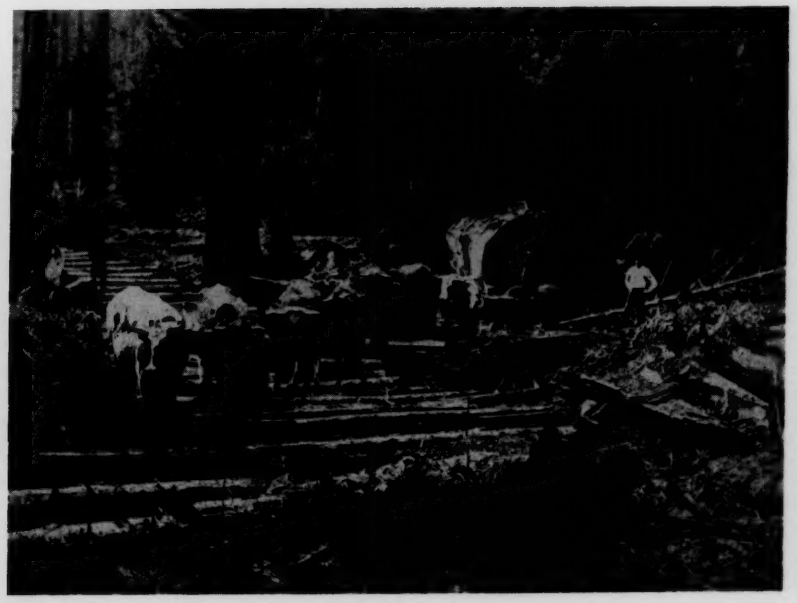
▲ Beavers need trees—and it can be said of some woodlands that trees need beavers: the chisel-toothed rodents are excellent thinners of overcrowded forests.



➔ Pine seeds are the Clark nutcracker's dish, and nature has provided the handsome bird with the instinct (or the wit?) to plant a nut now and then so that there will always be a pine tree.

▼ (RIGHT) Bullwhip logging in northern California was pictured by the author's uncle, Fred N. Sheldon, San Francisco photographer of earlier days. The skid road scene of 1889 is near Duncan's Mills in Sonoma County, the oxen pulling a log which was average for that era but is rare today. Some of the huge stumps can still be seen among the second growth.





The Cruise of the *Hassler*

JOSEPH L. PARKHURST, Jr.

THE FIRST serious student of deep sea life was a Manxman named Edward Forbes, who began dredging as a college student in the Irish Sea. After a dredging expedition to Greece in 1841 he came to the conclusion that animal life could not exist on the ocean floor below three hundred fathoms, and beneath it the sea was lifeless. This view had been widely held for about twenty years when broken telegraph cables were brought up encrusted with life in the Mediterranean, at a depth of more than twelve hundred fathoms.

Although Forbes died a young man his enthusiasm caught on and scientists around the world were fascinated with the prospects for unusual discoveries in the hidden recesses of the sea. In America deep sea dredging was first attempted by Louis François de Pourtales, an associate of the great naturalist, Professor Louis Agassiz of Harvard, and assistant in the United States Coast Survey. Pourtales explored the ocean bed off Florida in two surveying ships, and found a great deal of life at much greater depths than Forbes' theory had supposed.

In 1871 Professor Agassiz received a letter from the superintendent of the Coast Survey proposing a more extensive cruise in the new steamer *Hassler*, from Boston to San Francisco, going around South America. Although the professor had not been in good health this tempting invitation acted as a stimulant and he accepted it with characteristic zeal and readiness. One persistent idea in his mind was the belief that the depths of the sea would disclose many "living fossils," or primitive creatures unchanged since the earliest geological times.

The *Hassler* steamed out of Boston Harbor on December 4, 1871, with Professor and Mrs. Agassiz, L. F. Pourtales, and other distinguished naturalists on board. Passing through the Sargasso Sea on the way Agassiz had an opportunity to collect specimens from this strange region of floating seaweed. They had planned to test all the deep sea dredging apparatus off the Virgin Islands, but a rough sea interfered and this was delayed until Barbados. Near this island some of the richest hauls were made, bringing up the first "living fossils" that Agassiz had hoped to find, and some species unknown to science at that time, Possibly the most striking examples were a number of rare sea-lilies and feather-stars, belonging to a group of echinoderms which covered the shoals of ancient seas as starfishes and sea-urchins do today.

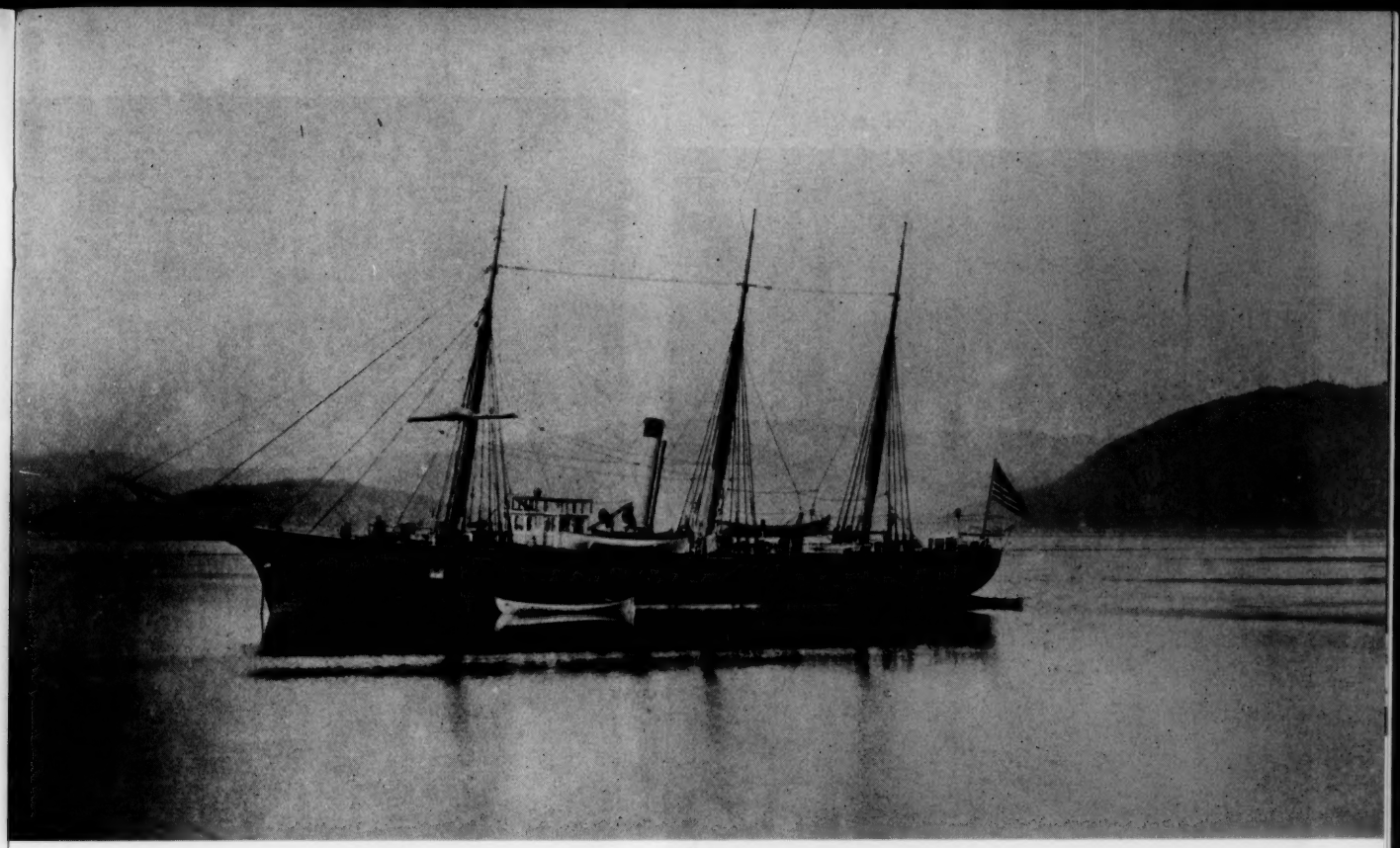
Continuing south along the Brazilian coast the *Hassler* called at the larger ports, casting the dredge with good results and sometimes hauling the seine on the shore. Some repairs had to be made in Rio de Janeiro and during this visit the ship's hold was accidentally flooded, causing some worry over the dredging line stowed below.

After reaching the Straits of Magellan in March, 1872, Professor Agassiz collected specimens in quantity from the beaches and tide pools, finding more echinoderms and some new species of jellyfishes. One of these tide pools, located on a terrace 150 feet above sea level, was populated with living mussels and several kinds of snails, in the same proportions as those on the shore. Such a location far beyond the reach of the tides indicated to Agassiz what must have been an ancient sea level and a recent upheaval. In addition he found many traces of glacial action in the rocks, suggesting an ice age here similar to that in the past history of the northern hemisphere.

Taking up a northerly course from the Pacific end of the straits, the *Hassler* anchored in the Chilean port of Concepción. Before going to Valparaiso they had planned to dredge from this port at Juan Fernandez, 400 miles at sea, in much greater depths than previously attempted on the expedition. At one point the dredge was lowered to 3,800 fathoms, but the tension was too much for the line and it snapped when hauled. Other disappointments followed in spite of cutting out the rotten sections of line, and Pourtales realized that the accident in Rio de Janeiro had spoiled his best efforts.

Meanwhile Agassiz had been traveling overland in Chile, absorbed in further studies of the southern ice age, and he rejoined the ship in Valparaiso. After more dredging in the shallower waters along the coast the expedition sailed for the Galápagos Islands, visiting each of them to probe into its natural history. Further collecting at Panama and Acapulco enriched the cargo of undersea treasures before the *Hassler* arrived in San Francisco at the end of August, 1872.

Although the results of their dredgings were inconclusive, giving only fragmentary answers to the broad questions Agassiz had in mind, his last adventure had been a success. Such an accumulation of valuable specimens, many of which were considered new finds, offered students at the Museum of Comparative Zoology an unparalleled opportunity. The cruise of the *Hassler*, coming just one year ahead of the world-famous *Challenger* expedition, was an American first in the dawning age of oceanography.



A Welcome to Agassiz—San Francisco: September 1872

ALONG six hundred miles of shore,
I heard one day the breakers roar;
A cheery sailor like refrain
It sounded, far across the main,
And like the mists it seemed to rise,
Or tears of joy in friendly eyes,
Until, in one grand peroration,
It burst in hearty salutation!

* * *

How the animal creation
Had a welcome jubilation,
And the sea-stars and *Echinus*
Said, "We hope that he will find us";
And the whelks and periwinkles
Laughed their faces full of wrinkles;
And the crabs and lobsters, too,
Drummed on their shells a brisk tattoo,
And the *Octopus punctatus*
Joined the jolly jubilatus,
While the festive trap-door spider
Flung his gate a little wider.
And the tree-toads in the willows,
And the fishes in the billows,
And the birds among the branches
Of the trees upon the ranches,
All in unison were humming,
A welcome for the Master coming!
The "graybacks" off the Farallones
Rushed round as if they'd break their bones;
The blackfish and the sleek porpoises,
Were making most exultant noises;
Out at Seal Rocks, the lions there,
Danced a fandango in the air,
Their flippers flapped and wagged their tails,
When they beheld the good ship's sails;
The grizzlies in the hills of Napa
Stood on their heads they felt so happy;
And many a fossil "elefunt"
Felt sad because he couldn't grunt;
The giant clams, great *Schizothærus*,
Were glad to learn that he was near us;
And when the good ship crossed the bar,
"They whispered to themselves, "huzza!"

* * *

How the inanimate creation
Mingled in the jubilation!
The mountains staring at the sea
Were wondering what the muss could be;
But looking down upon the tide,
They felt an earthquake thrill of pride,
For floating lightly on the bay,
The "Hassler" like a sea-bird lay,
And then Mount Shasta said "God bless her!
She's brought us safe the great Professor!"
And from the mammoth trees *Sequoia*,
A voice came, "We've been waiting for you
Some fifteen hundred years or more—
Why haven't you been here before?
The 'Old Maid' now will fall in love!"
Thus spake the Calaveras grove.
The glaciers, pausing on their way,
Said "We've been waiting many a day
And watching anxiously the passes,
To give a greeting to Agassiz."
"Ha!" spoke a smouldering volcano,
"Professor Agassiz? Bueno!"
While far and wide each steaming geyser
Responded with a shrill "Aye! Aye! Sir."

* * *

How the people sang "Te Deum,"
When they heard who'd come to see 'em!
How everybody there and then
Felt in their hearts a glad Amen,
While e'en Joe Bowers from the grave
Rose up and gave his hands a wave,
And told the story o'er in full,
About the Calaveras skull;
And China John, in soles of wood,
Was heard to mutter, "belly good."

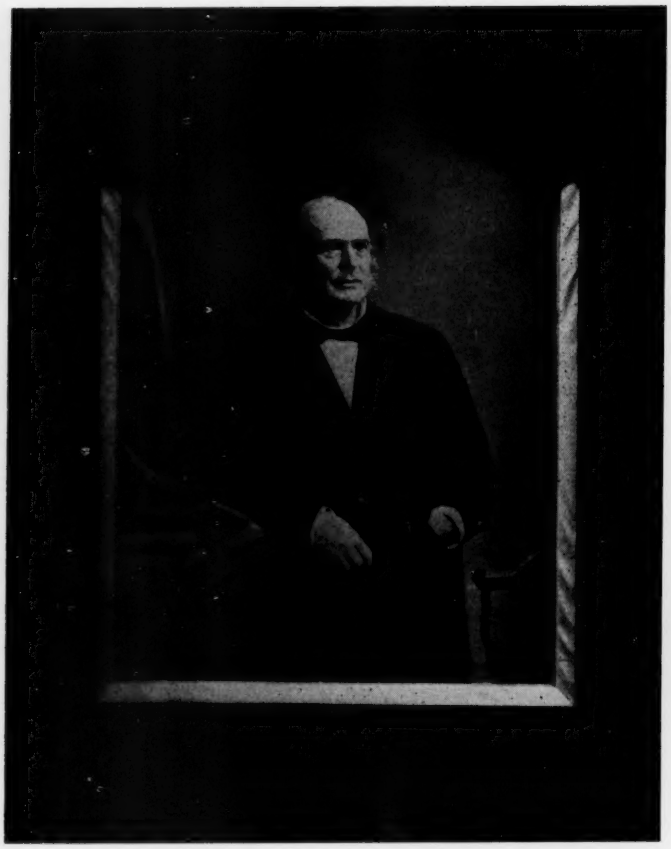
* * *

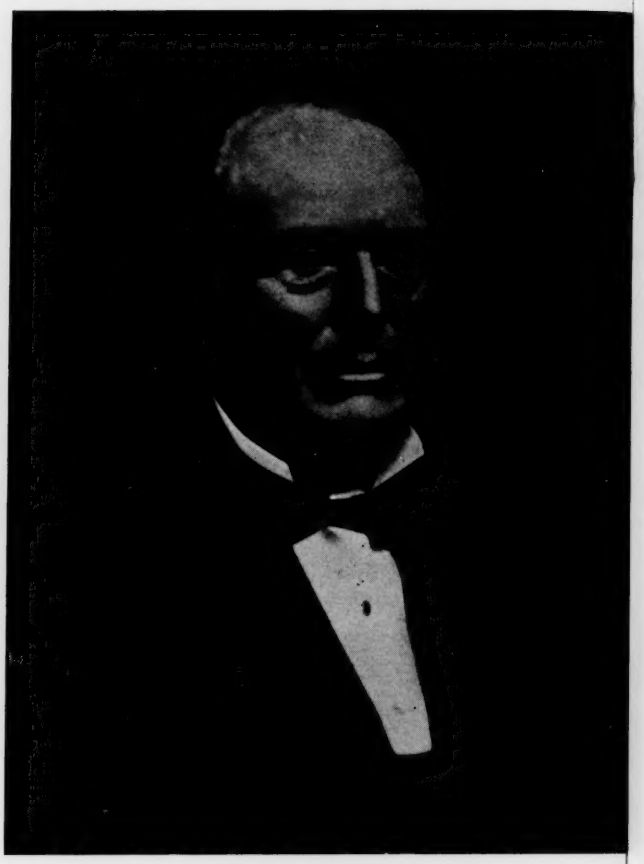
A welcome to the genial face,
The generous heart, the friendly hand,
From me and mine to thee and thine
A welcome to the land.
A welcome to the sunset land,
From all its sons and all its daughters;
A welcome to its vine-clad hills,
Its fertile vales and healing waters;
A welcome from its mountain peaks,
A greeting from its wondrous valleys;
A welcome to its mighty groves
And all their shaded alleys.
The golden gate of friendship swings
wide open when you come,
And says to you, and Madam, too,—
"Now make yourselves at home."

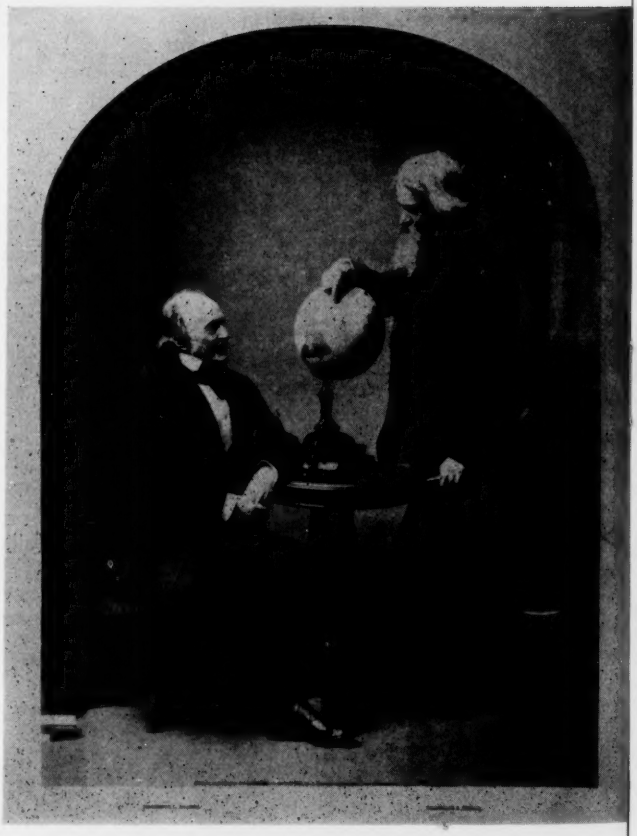
R. E. C. S.

San Francisco, September, 1872

▲ U.S.S. *Hassler*, "an experimental [steam dredger] of deep-draft and double-hulled construction" (Lurie, p. 374), was completed in 1871 at Camden, New Jersey. Length, 154 feet; beam 24.7 feet; draft, 12 feet; tonnage, 319.49. Officers on this maiden voyage were Commander P. C. Johnson, Lt. Commander C. W. Kennedy, Chief Engineer Henry E. Rhoades (Panama to San Francisco—two other engineers were discharged for drunkenness). Agassiz's party included Rev. Thomas Hill, Dr. Franz Steindachner, Dr. J. William White, and Dr. Henry S. Pitkins. (Official U.S. Coast and Geodetic Survey Photograph)







Among the several photographs of Louis Agassiz in his later years, there are a number taken during the *Hassler's* stop in San Francisco. The two above were made by Bradley & Rulofson (the one to the left reproduced courtesy Department of Zoology, University of California, Berkeley, where a large framed copy hangs). With Agassiz in the twosome below is Professor Benjamin Peirce, head of the U.S. Coast & Geodetic Survey, who proposed the *Hassler* voyage to the great scientist and put the new ship at his disposal (date of photo is 1869).

The Agassiz story

Louis Agassiz: A Life in Science. By Edward Lurie. The University of Chicago Press, Chicago. 1960. xiv + 449 pp., 24 pp. of halftones. $7.50.

The year 1859 was a signal one in science—for the world, with Darwin's publication of his *Origin of Species*; for the United States, with Louis Agassiz' realization of a dream in the opening of the Museum of Comparative Zoology at Harvard. Consummate irony enters at this juncture in Agassiz' being the militant chief antagonist of Darwin's theory of evolution, on this side of the Atlantic. The Swiss-born naturalist who built his world reputation at 30 on his theory of an Ice Age (1837), who came to our shores in the "Year of Decision" (1846) and in a few short years through the force of his personality, the weight of his authority, and his genius for organization had succeeded in institutionalizing American science and bringing it into full maturity—this lustrous figure of a new age of enlightenment in science, indeed, it was who dedicated himself to the task of shielding the American public

ACADEMY OF SCIENCE.

Professor Agassiz Makes a Speech.

A Few Practical Suggestions to Our Millionaires.

* * *

The announcement that Professor Agassiz would be present at the meeting of the Academy of Sciences last evening attracted the largest audience that we have ever seen assembled in the rooms, including a large number of ladies.

The regular business was dispensed with, and Professor Davidson, President of the Academy, introduced the world-renowned savant.

Professor Agassiz' Remarks.

Gentlemen: It gives me very great pleasure to be among you, and I recollect, twenty years ago, when I heard your Academy was about being founded, I longed to come and help those who were then struggling to establish a scientific association in the midst of a community so young and in a country so comparatively uncivilized. My interest is increasing since I see you have raised

A STANDARD OF INTELLECTUAL CULTURE

In this city. I have felt that you were doing a good thing not only for San Francisco and California, but for the whole United States. You have shown great zeal amid your many difficulties, and deserve credit for your efforts. I hold that your reason for thus laboring is a desire to elevate the intellectual standard of the community. You are surrounded with wealth—have men among you richer than the kings of the Old World—but I see [glancing around the small room] you are still in close quarters, and unable, for lack of room, to properly display the many curious and valuable acquisitions you possess.

YOUR MILLIONAIRES

Should follow the noble example set by the rich men of Massachusetts. Twenty-five years ago I commenced single-handed to teach the department of natural history in a college of that State. When I commenced there was not a single instrument to illustrate what I taught. By and by wealthy men became interested and saw that a museum would be of great use. When this was recognized, means were gradually forthcoming in small contributions at first, but increasing rapidly. Now, after a period of fourteen years, the museum of Cambridge is an institution second to none in the world. It differs from those of the Old World in many things. Institutions of a like character there were organized with the means and appliances then at command, and have made

COMPARATIVELY LITTLE PROGRESS,

So that they are now in a measure superannuated and cannot be rejuvenated. Our little museum in Cambridge was started in accordance with the ideas of to-day, and in consequence such materials were collected as had a bearing on questions of the times. There was every facility for that from the very organization of the museum. They have since extended the facilities and materials. I have been supplied with abundant means for all the wants of the institution. Now, you are a richer people than the Bostonians, and should have a fine museum, so as to produce observers and not mere theorists. The world wants men to learn what is not yet known, not men to learn from books, but in

THE GREAT SCHOOLROOM OF NATURE.

The student who has not time to pursue his researches in the field, must have facilities to study in his laboratory. What would you think of a physician, or a lawyer, who was obliged to go out and till the soil that was to furnish him bread? The scientific man must lose much valuable time unless he has all the appliances. I hold that one of the duties of those who are possessed of wealth is to help those who have the desire and intellect to carry on scientific research. . . .

Day before yesterday, when I passed through the Golden Gate and saw San Francisco for the first time, I was fairly amazed. It seemed to me the marvel of modern times that there should be so rich, prosperous, grand, and still so young a city on these shores. What you have achieved in pecuniary resources you can equal in intellectual activity. [Applause.]

* * *

Professor Agassiz was then called upon to give a brief outline of what had been accomplished during the cruise of the *Hassler*. . . .

SAN FRANCISCO CHRONICLE
Tuesday, September 3, 1872.

[*Reprint courtesy California State Library*]

---

against the pernicious gleam of the insidious new theory, after the fateful year of 1859. Ironically enough for Agassiz, he had to go to the lay public for support of his own defensive structure of special creation and immutability of species, because to his American friends and erstwhile devotees in science—Asa Gray, J. D. Dana, W. B. Rogers, J. Wyman—he had, alas, become more a clever theologian than an objective scientist. Thus a grand conflict of ideas and personalities assumes the impact of plot under the skilful hand of historian Edward Lurie (he is chairman of the American Studies Program at Wayne State University) in his *Louis Agassiz*. The final twist of fate for Louis Agassiz (to pursue the irony bit) was borne to him on the sea. (Possibly there is a thing here. . . .) Free winds blowing, boundless horizons inviting, new lands beckoning—and Darwin returned to Downs from the voyage of the *Beagle* with the seeds of a world-shining new concept well planted in his awakened mind. It was on the hemispheric voyage of the *Hassler* (my only plaint to Mr. Lurie on his sharply illuminating biography is for his relative slightness with the sea journey itself) that in his penultimate year the great man, who for a quarter century had basked in the public eye as its image of the world naturalist, who privately could not challenge his own most cherished convictions, felt the faint stirrings of impending sea-change in the set of his mind. He could write from his deck chair to a colleague: "I had a special purpose in this journey. I wanted to study the whole Darwinian theory free from all external influences and former prejudices. It was on a similar voyage that Darwin himself came to formulate his theories!" And, Lurie says, he "went on to admit that the Darwinian idea might very well be true. . . ." But he died the next year, unconvinced.

The book was exquisitely designed by San Francisco's own Adrian Wilson. It is minor criticism to note that the index lacks completeness—*e.g.*, no independent "Hassler" entry. D.G.K.

The world in a paper wrapping

THE PROBLEM of acquiring a basic natural history library faces everyone with a serious interest in nature and the out-of-doors. Of course there are public libraries. But I think with most naturalists a love for books comes second only to their love for nature—and the private library in office, living room, or den is where the important books belong. Indeed, it is the dream of most young naturalists to some day have a den with at least one wall covered with books from floor to ceiling.

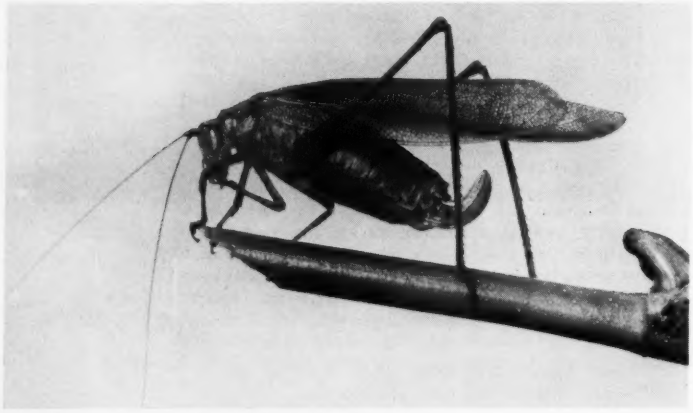
As a youngster your nature columnist sold butterfly and moth eggs and pupae to dealers and collectors in the eastern United States. And I must confess that most of that money went directly into books. As I recall, the first two books in my library were *Butterflies of California* by John Adams Comstock and *Insects of Western North America* by E. O. Essig. But those were very expensive books for the depression years and, in fact, would even be considered expensive today. The amount of money invested in those two books alone could provide the beginning naturalist of today with a private nature library of many volumes. A few years ago this was not true. It is so today because of what has been called the "paperback revolution."

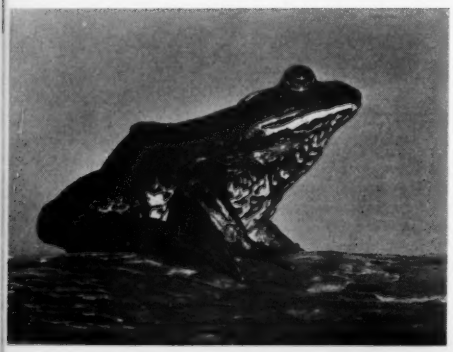
Of course, paperbacks have been with us for a long time. The Buffalo Bill, Frank Merriwell, and Horatio Alger dime novels of half a century ago will be remembered by many. At the other end of the scale digests of college courses have long been available in the College Outline Series. Since 1939 pocket-size paperbacks have appeared in ever-increasing numbers, particularly as detective or western stories. Rather odd-shaped paperbacks covering all sorts of subjects were distributed in great numbers by the Armed Forces during World War II. Perhaps this was the real genesis of our so-called paperback revolution.

Today there seems to be no limit to what is available in inexpensive paperback editions. There are now nearly 14,000 paperback books in print with about 180 new titles added each month. Many are reprints of earlier hardcover editions but others are originals. Some publishers include an occasional natural history title but during the past year complete natural history libraries have also been offered. A few years ago most paperbacks were priced at either 50 cents or one dollar. Today prices of $1.25, $1.45, $1.95, or even $2.25 are common for quality paperbacks.

Paperbacks are now sold extensively in bookstores as well as on newsstands and, with the relatively recent advent of the quality paperbacks, are required reading in many high school and college courses. This boomed sales to nearly a million a month in 1960.

The naturalist will have no difficulty finding books on his favorite subject among the current offerings of the regular book publishers or certain organizations with a special interest in natural history. Some of the newer titles are listed below and below is a suggested $25 bookshelf for the beginning naturalist who wants to start his own library.

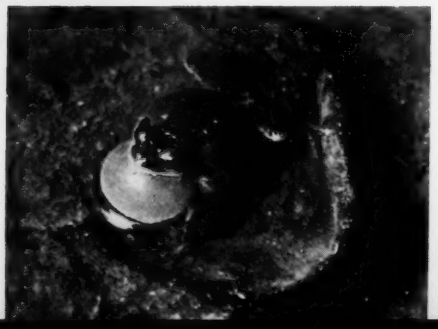




↑ Katydid. (Gayle Pickwell)

← Bullfrog (*Rana catesbiana*). (A.C.S.)

↓ Pacific Treefrog (*Hyla regilla*). (Gayle Pickwell)



A $25 nature library

Modern Science and the Nature of Life. By William S. Beck. Doubleday Anchor. $1.45.

The Plant Kingdom. By Harold C. Bold. Prentice-Hall. $1.50.

Animal Behavior. By Vincent Dethier and Eliot Stellar. Prentice-Hall. $1.50.

Man in Nature. By Marston Bates. Prentice-Hall. $1.50.

Insect Life and Insect Natural History. By S. W. Frost. Dover. $2.49.

Culture Methods for Invertebrate Animals. By James G. Needham, et al. Dover. $2.75.

Animal Ecology. By W. H. Dowdeswell. Harper Torchbooks. $1.50.

The Forest and the Sea. By Marston Bates. Mentor. 50¢.

Adventuring with Beebe. By William Beebe. Viking Press. $1.25.

The Mountains of California. By John Muir. Doubleday Anchor. $1.25.

The Exploration of the Colorado River. By John Wesley Powell. Doubleday Anchor. 95¢.

John Burroughs' America. Edited by Farida A. Wiley. Doubleday Anchor. $1.45.

The Sea Around Us. By Rachel Carson. Mentor. 50¢.

How to Know the American Marine Shells. By R. Tucker Abbott. Signet Key. 75¢.

Handbook of California Birds. (or other local bird book). By Vinson Brown and Henry G. Weston, Jr. Naturegraph. $2.95.

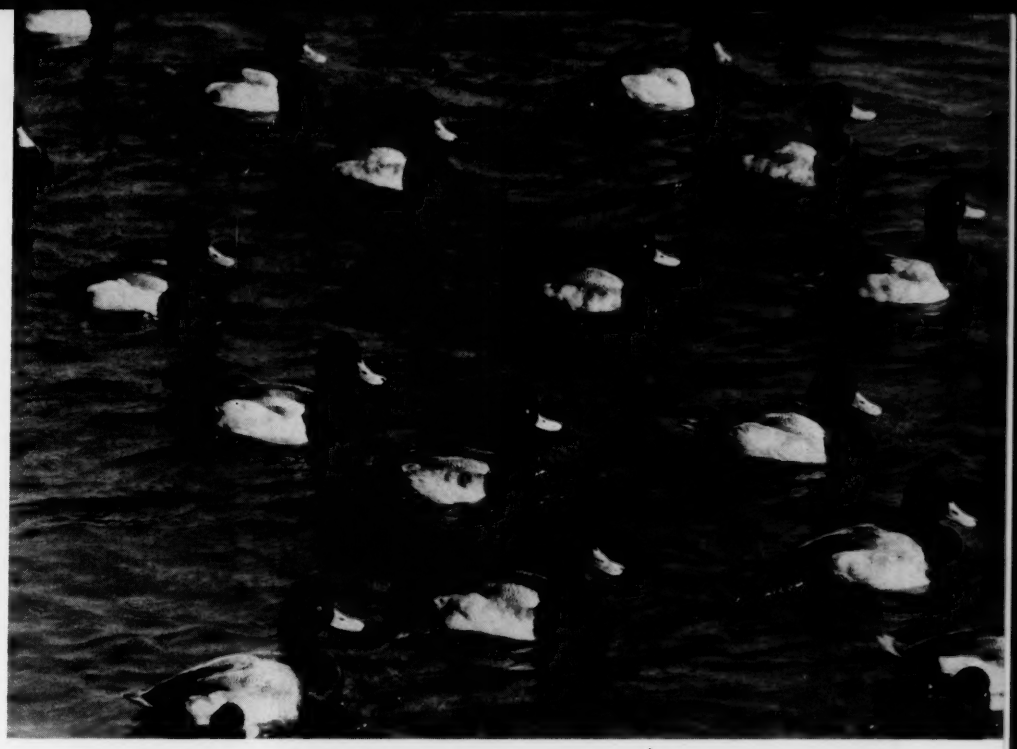
California Spring Wildflowers. (or other local flower book). By Philip A. Munz. University of California Press. $2.95.

Total cost of above books, $25.24. More paperbacks are listed on page 33.

WITH

ARTHUR C. SMITH

Paperbacks and Platters



Scaup Duck formation. (Allan D. Cruickshank)

Wild voices

THE APPRECIATION OF NATURE through observing birds, insects, and other creatures has been a source of enjoyment for many down through the ages. Listening to birds, insects, frogs, and other animals may be less well-known to the general public but this also gives great pleasure to an ever-increasing number of nature enthusiasts. Until rather recently it was almost necessary to have personal instruction from an expert in order to learn to distinguish species by voice (as a matter of fact, it still helps!). Today, however, there are available excellent recordings of the voices of many different kinds of animal songsters so that the "learn it yourself" approach is quite possible.

For the past 25 years Professors Arthur A. Allen and Peter Paul Kellogg of Cornell University have recorded bird voice from the Atlantic to the Pacific and from the jungles of Panama to the barren grounds of Hudson Bay. Their newest record is especially appropriate at this time of year. It is *Dawn in a Duck Blind: A Guide to the Calls of Waterfowl* (Cornell University Records: 33⅓ RPM; $5.95).

For many years the nature records of Dr. Allen and his co-workers at Cornell and other collaborators were virtually the only ones on the market. Since World War II and particularly with improvements in tape recording many workers have begun recording the sounds of nature. As with nature books, the westerner is still somewhat "short-changed" in the total offering but nevertheless there are many nature records of great interest and usefulness for us. Recorded for our study are not only the songs or sounds of birds, crickets, katydids, frogs and toads, but also of rattlesnakes, fishes, monkeys, lions, sea lions, farm animals, tropical rainstorms, and many others. Some of the most interesting records are listed below:

Bird Songs (Recordings):

Western Bird Songs. Recorded by William R. Fish. Produced by P. P. Kellogg and A. A. Allen. Cornell University Records; 78 RPM. 10 species. $2.50.

Western Bird Songs of Dooryard, Field and Forest. Recorded by Jerry and Norman Stillwell. Ficker Records, Old Greenwich, Conn. 33⅓ RPM. 68 species. $7.95.

A Field Guide to Bird Songs. Produced by P. P. Kellogg, A. A. Allen and Roger Tory Petersen with 27 collaborators. Houghton Mifflin. 33⅓ RPM. 300 species. $10.95. This record accompanies Peterson's eastern field guide but nearly half of the species may also be heard in the West. A new record to accompany the western guide should be out next year.

The Mockingbird Sings. Supervised by C. Russell Mason. Produced by P. P. Kellogg and A. A. Allen. Cornell University Records. 78 RPM. $2.50.

Songs of Spring; Sounds of Nature; Birds of the Forest; Songs of Warblers of Eastern North America. Recorded by William W. H. Gunn. Federation of Ontario Naturalists. 33⅓ RPM. Number of species varies. Priced from $4.95 to $5.95.

The songs on these records are mostly of eastern birds but are so interesting and well done that they are worth hearing.

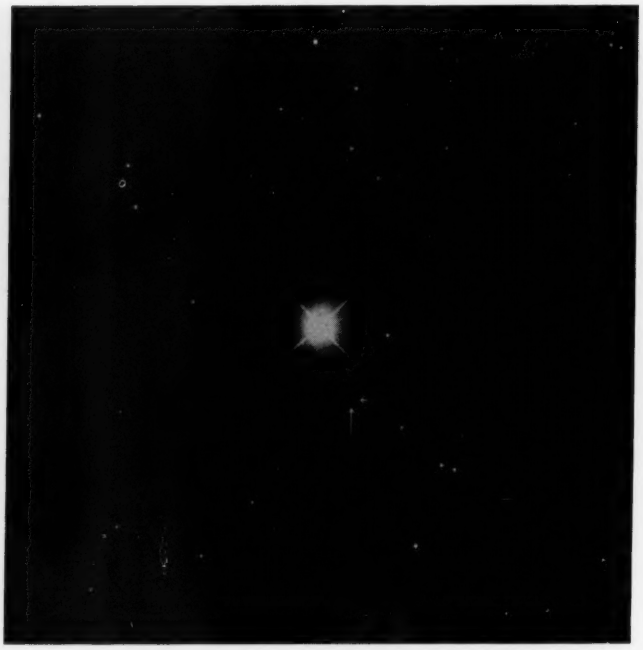
Bird Songs in Your Garden. Text and photographs by Arthur A. Allen. Recording by Peter Paul Kellogg. Cornell University Records. 33⅓ RPM. 25 species. $4.95. Also primarily eastern but includes some western

(Continued on page 33)

Professors Arthur A. Allen (standing) and Peter Paul Kellogg, Cornell University's world-famous ornithologists, who have built up the Library of Natural Sounds in the University's Laboratory of Ornithology, operating a parabolic reflector. (Cornell University Records)

PLUTO—The Planet Beyond

FOR FIVE THOUSAND YEARS man's knowledge of the universe rested upon seven celestial bodies that slowly moved among the stars; the sun, moon, and the five naked-eye planets. The universe appeared changeless. To the eyes of early astronomers it was changeless. And then the inevitable happened. On March 13, 1781, an English amateur astronomer, William Herschel, wrote in his notebook: "In the quartile near Zeta Tauri, the lowest of two is a curious either nebulous star or perhaps a comet." Had this object been a



comet, it would have stirred little interest, but it moved slowly among the stars with a motion quite different from that of an ordinary comet. In reality, Herschel had discovered a new planet—the first since prehistoric times. The planet was given the name Uranus.

This discovery immediately brought up the possibility of the existence of other planets beyond Uranus. In fact, this possibility was strengthened after astronomers noted the motions of Uranus. An orbit for Uranus was computed to allow astronomers to determine the position and motion of the planet at future dates. Early observations, however, showed Uranus to be departing from its calculated path. Several astronomers believed that there was yet another planet farther out than Uranus that was exerting a gravitational influence upon the planet, thus pulling it from its prescribed orbit. From the observed deviations of Uranus, J. C. Adams in England and the French mathematician U. J. Leverrier independently computed the position of this mystery planet. Using this theoretically predicted position, J. G. Galle found the planet Neptune on September 23, 1946, within one degree of the spot predicted by these mathematicians. This discovery represented the most remarkable achievement in theoretical positional astronomy and was a great triumph for Newtonian laws of motion and for the Universal Law of Gravitation.

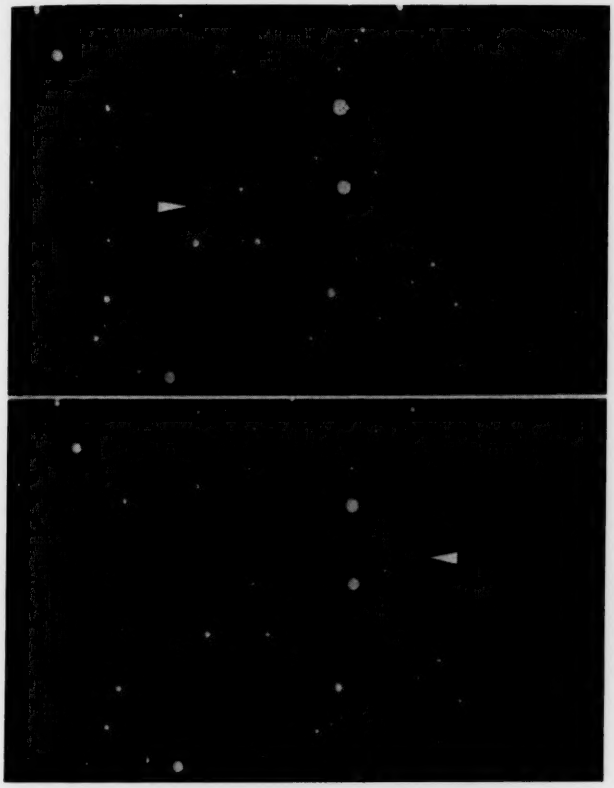
Even after Neptune's discovery, there still remained small but disturbing discrepancies in the predicted motion of Uranus. Although some workers tried to explain these deviations as being due to the existence of "families" of comets having their aphelion positions beyond Neptune, a few astronomers were convinced that another planet lay beyond the one newly discovered. Among these was Percival Lowell.

From the observed residual perturbations of Uranus, Lowell attempted to determine the position of this "Planet X" as it came to be called before its discovery. He also attempted to predict the mass of the object as well as its mean distance from the sun. The problem of finding a trans-Neptunian planet was far more difficult than finding Neptune itself. Lowell could not use the perturbed motion of Neptune in his calculations, for Neptune had not yet moved far enough on its 165-year orbit to provide useful and accurate data. In 1915, Lowell presented to the world the results of his efforts. In his paper, "Memoir on a Trans-Neptunian Planet," he predicted the position that the planet should occupy and estimated that it would have a mass seven times that of the Earth and a mean distance of 43 Astronomical Units from the sun (4 billion miles). Assuming that the planet had a low density similar to the giant planets Jupiter and Saturn and a high albedo (percentage reflection), he estimated that the object would have an apparent magnitude of about 12. This would be on the order of 100 times fainter than a 6th magnitude star, the faintest star visible to the unaided eye.

The difficulty of predicting the position of a trans-Neptunian planet cannot be overemphasized. But the problems involved in locating such a faint starlike object on a photographic plate that might contain thousands of similar-looking objects are almost insurmountable. To complicate matters even more, Lowell predicted the position of the hypothetical planet to be close to the winter milky way which contains millions of stars of the predicted magnitude. Nevertheless, a systematic photographic program was begun at Lowell's private observatory in Flagstaff, Arizona in 1905. Using a 5-inch lens, some 200 photographs of the predicted area were made. This would represent 100 areas, for a duplicate was made of each area a few days after the first photograph in attempts to detect any motion of the elusive planet during this period. Unfortunately, fast films and wide angle sky cameras did not exist at the beginning of the 20th century which hindered the search. This first program was met with complete failure. We know today that the planet's inclination to the plane of the solar system at that time placed it just off of the southern edge of the photographs!

After some delay, the search was resumed in 1914

▲ (LEFT) Pluto on 4 March 1930. The bright star is Delta Geminorum; the four rays extending from it are caused by diffraction around the secondard mirror supports of the Lowell 42-inch reflector. (Lowell Observatory, Flagstaff, Arizona; photograph by C. O. Lampland) ➔ (ABOVE, OPPOSITE PAGE) Top photo shows Pluto, 23 January 1930; bottom, Pluto six days later, 29 January 1930. Both are reproduced from the original Pluto discovery plates. (Lowell Observatory photos)



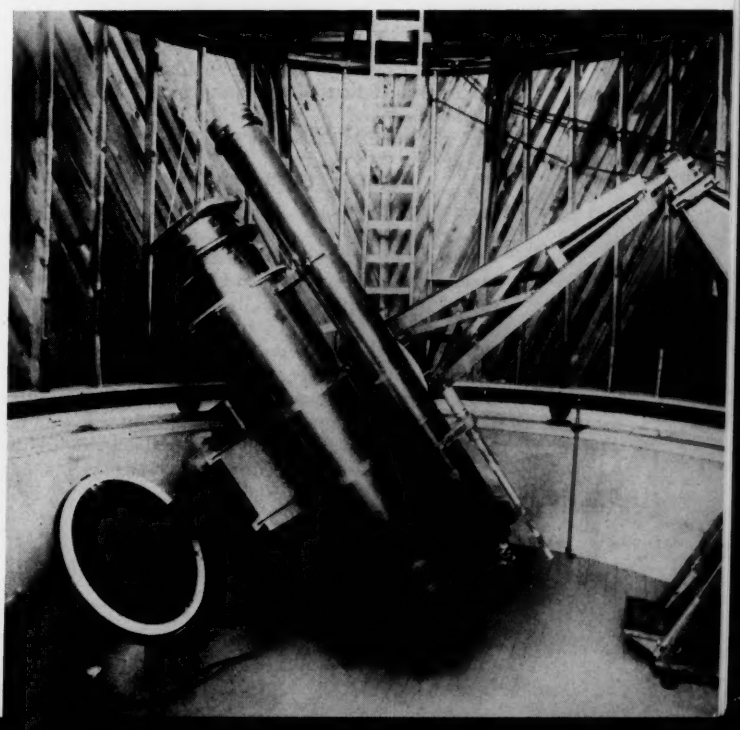
after the Lowell Observatory received on loan a 9-inch telescope. From 1914 to 1916, numerous photographs were taken with this new instrument but still no sign of the planet was found. On November 16, 1916, Lowell suddenly died. For 13 years after, the search lay idle and Planet X remained undetected.

Up to the day Lowell died, he was firmly convinced of the existence of this planet somewhere in his predicted position. Fortunately, he had supporters at Lowell. V. M. Slipher, the director of Lowell Observatory after Lowell's death, E. C. Slipher, and C. O. Lampland were among the very few who still shared the optimism of Lowell. In 1919, W. H. Pickering of Harvard Observatory recomputed the position of Planet X but this time using the perturbed motion of Neptune, and arrived at the same conclusions that Lowell had made. He predicted, though, that the planet would be a 15th magnitude object, some sixteen times fainter than earlier estimates.

Finally the search was resumed at Lowell in 1929 with the acquisition of a special 13-inch astrographic camera constructed especially for such a search and donated by Lowell's brother, Dr. Lawrence Lowell. At about the same time, a young graduate student joined the staff at Lowell. The main job for 23-year-old Clyde Tombaugh was to use this new camera to search for the hypothetical planet. Another instrument was employed to speed up the plate examinations. Lowell used only a hand lens to examine the many thousands of star images on his photographs during the earlier search program. This was at best a slow and tedious operation. Tombaugh had at his disposal a blink comparator or microscope to aid him in the examination of the plates. Two plates of the same area are taken a few days apart and then they are placed in the comparator. As an observer looks through the comparator, he sees a rapidly alternating view of the same field of view on the two plates. If, during the few days between exposures, any object has changed its position with respect to the stars, it will appear to jump from one place to another as the photographs are alternated.

Actual systematic observations began in April of 1929. For months Tombaugh patiently photographed various regions of the sky and "blinked" the pairs of photographs in the comparator. Many unforeseen problems began to show up. Silver grains would tend to aggregate upon development, producing thousands of faint planet suspects. These had to be watched for and checked carefully. Hundreds of objects that at first appeared to be the sought-for object turned out to be faint variable stars (stars whose light varies over a given time) that were below the limiting magnitude of one photograph and during the waiting interval obtained a brightness sufficient to make a faint impression on the following plate. Numerous minor planets or asteroids located in orbit between Mars and Jupiter were picked up on the plates. Their motions, however, are fairly rapid and normally revealed themselves as small streaks on the plates during the hour-long exposure. Sometimes these asteroids would show rapid westward motion (retrograde motion) as they reached opposition and the Earth passed them. Occasionally an asteroid would be caught in its stationary position on its orbit a few weeks before or after opposition which made them appear during this time as a very slow-moving distant planet. Special precautions had to be taken to correctly identify these objects.

Winter approached and the job became more and more tedious. The number of stars on the plates began to increase enormously as the winter milky way was



The Lawrence Lowell 13-inch photographic telescope. This is the instrument used in the discovery of the far-out Pluto.

approached. While Tombaugh made his way slowly through western Gemini, he encountered up to 400,000 stars on some photographs! Each star had to be examined for the Planet X. This necessitated the use of diaphrams to obscure all but a small area on the photographs so as to reduce the number of stars. The examination routine slowed down and fell behind the photographic schedule. By February 1930, after completing the examination of the region of eastern Taurus, Tombaugh set aside the rich star region of western Gemini and began examining those of eastern Gemini that contained the 3rd magnitude star Delta Geminorum. These plates were taken on January 21, 23 and 29 respectively. After blinking about one fourth of the plate he suddenly noticed a 15th magnitude object near Delta. One can imagine the great excitement that must have prevailed as he caught the first glimpse of the planet Pluto. His own description follows:

The experience was an intense thrill because the nature of the object was apparent at first sight. The shift in position between January 23 and 29 was about right for an object a billion miles beyond Neptune's orbit. Since the plates had been taken at opposition, I was confident that the object was not an asteroid. The images were sharp, not diffuse; hence, there was no suggestion that the object was a comet. In all the two million stars examined thus far, nothing had been found that was as promising as this object. It was about two magnitudes brighter than the faintest stars recorded on the plates. At once the plates on the 5-inch telescope, taken simultaneously, were inspected with a hand magnifier. There, too, were the images of Pluto, clearly confirmed, exactly in the same positions! The images were quickly found on both plates of January 21, the positions conforming with the motion indicated by the plates of January 23 and 29. Therefore, I informed the Director and other members of the staff, who came to take a look.

One month followed during which intensive observational work was done upon Pluto. A chart was constructed of the stars in Pluto's vicinity and visual observations were made with the Lowell 24-inch refractor. Some disappointment was had when, as the Lowell staff peered through the eyepiece, they could see no perceptible disc but only a faint point of light almost lost among the stars. Finally the astronomers were satisfied that this was the ninth planet of the solar system and on March 13, 1930, Lowell's birthday, the colossal discovery was made known to the world.

An interesting sidelight to this story concerns the naming of the planet. The name "Pluto" was first suggested by an 11-year-old English girl to the professor of astronomy at Oxford University. The astronomer sent this suggestion to Lowell Observatory and out of many other names, it was the one chosen. It is appropriate in several ways. Pluto in mythology was the God of the Underworld, the world of perpetual darkness. What planet would be better suited for this name than a small world at a distance so far from the sun that the sun appears only as a bright star with no discernible disc? Pluto is in perpetual cold and darkness. It was also noted by the Lowell astronomers that the first two letters of "Pluto" were P and L designating Percival Lowell. From that time forward, the astronomical symbol for Pluto has been P.

Further studies have raised some questions as to whether this object is really the planet Lowell sought. Pluto's mass seems to be too small to account for the perturbed motions of Uranus and Neptune. However, the planet was found only 6° from Lowell's predicted position and its magnitude and distance agree too well with his calculations for this object to be other than the ninth planet. One can only marvel at the tireless perseverance of the Lowell staff as they optimistically searched among over 20 million objects of equal brightness and appearance for the one planet Percival Lowell knew was there. O.R.N.

SKY DIARY

October, November, December, 1961

(All Times are PACIFIC STANDARD TIME)

Phases of the Moon

Last Quarter	October 1	6:10 A.M.
New Moon	9	10:53 A.M.
First Quarter	16	**8:35 P.M.**
Full Moon	23	**1:31 P.M.**
Last Quarter	31	00:59 A.M.
New Moon	November 8	1:59 A.M.
First Quarter	15	4:13 A.M.
Full Moon	22	1:44 A.M.
Last Quarter	29	**10:19 P.M.**
New Moon	December 7	**3:52 P.M.**
First Quarter	14	**12:06 P.M.**
Full Moon	21	4:42 A.M.
Last Quarter	29	**7:57 P.M.**

The Planets

Mercury: can be seen during the first week of October low in the western sky in early evening. It is graduallv moving toward the sun and arrives at inferior conjunction on October 22. It will not be seen again until the first week in November when it will appear as a morning object almost lost in the dawn light. Mercury reaches greatest elongation west on November 7, some 19° west of the sun, but is not favorably placed for observation. During the month of December it is too close to the sun to be seen. Superior conjunction occurs on December 16.

Venus: a morning object, rapidly approaches the sun in October and November. It will be too close to the sun to observe by the end of November, being only 15° west. Venus will be lost in the sun's glare throughout the month of December.

Earth: reaches heliocentric longitude of 90° on December 21. It is then the shortest day of the year for northern and the longest day for southern peoples. At this time winter begins in the northern hemisphere and summer in the southern. The sun at noon stands directly overhead on the Tropic of Capricorn.

Mars: remains an insignificant +1.5 magnitude object in Virgo and sets in the evening twilight by the first of October. It will be too close to the sun to be observed throughout these three months.

Jupiter: dominates the southern sky in the early evening during these months. It can be found moving solwly through Capricornus and shining at —1.8 magnitude by the end of October. The giant planet will set at local midnight in October and early November but by the end of December it will be seen only 30° east of the sun and will then set about 2 hours after sunset.

Saturn: follows Jupiter in Capricornus. It remains a rather inconspicuous object shining at magnitude +0.8. By mid-December it will be setting only 1.5 hours after the sun. Interesting configurations of Jupiter, Saturn, and the moon will be seen through these months, produced when the moon enters into conjunction with these planets. O.R.N.

Cook, but more than tour

The Voyage of the *Resolution* and *Adventure*, 1772–1775. Edited by J. C. Beaglehole. [Volume II of *The Journals of Captain James Cook on His Voyages of Discovery*, edited from the original manuscripts by J. C. Beaglehole with the assistance of J. A. Williamson, J. W. Davidson and R. A. Skelton. Hakluyt Society: Extra Series No. XXXV.] New York: Cambridge University Press. Published for the Hakluyt Society. 1961. clxx + 1021 pp., Frontis. in color, 82 illus. and maps. $19.50.

More than five years ago *Pacific Discovery's* masthead page (March-April 1956) announced a most notable event in the publishing history of the annals of discovery. This was the appearance in that year of Volume I of the present four-volume series, *The Voyage of the* Endeavour, *1768–1771*, edited by the same distinguished historian of Pacific exploration (it was accompanied by the large *Portfolio* of 88 reproductions of original charts and views drawn during the course of Captain Cook's three voyages). This reviewer confesses to considerable impatience over the prolonged wait for this second volume, being one of those peculiar people for whom such a book has an almost pathological fascination. My state of expectancy has been sustained since early April 1958 when Professor Beaglehole told me, when he so cordially received me at his office in Victoria University of Wellington, New Zealand, that he was nearly finished with his work on the second volume. But for various reasons it has been delayed in press (let us hope that it will not take another five years to bring out Volume III: *The Voyage of the* Resolution *and* Discovery, *1776–1780*, which would have been so appropriately reviewed in our foregoing special Hawaii issue, or yet another five to complete the series with Volume IV: *Cook's Life and Voyages: essays and lists.*

The nearly two full centuries of prime exploration of the earth, its land, seas, and skies, since James Cook sailed the *Endeavour* around it, have not diminished the stature of the great seaman who first made long-range oceanic exploration a scientific achievement rather than a foolhardy adventure with poor odds for survival. On the contrary, Cook's second voyage, "in the annals of exploration, is unsurpassed for grandeur of design and execution and for variety of experience."

On his second voyage Cook ran the first European ship across the Antarctic Circle (his farthest south, 71° 10′), navigating in ice with great skill; he "left a mere handful of Polynesian islands undiscovered"; in the more than three years he did not lose a single man to scurvy—an unprecedented triumph over the dread scourge. Never before had such complete and wide ranging scientific observations been made—in hydrography, meteorology, glaciology, natural history, and ethnology. On this voyage were two astronomers, Wales and Bayly, the naturalists Forster, father and son, the artist, Hodges, and three draftsmen, besides servants to some of these people. Cook himself is replete with observations on the natives of the various islands visited; and more are to be found in the appended "Extracts from Officers' Records" – Furneaux, able commander of the *Adventure*, Burney, Clerke, Pickersgill – and in the "Journal of William Wales."

All in all, this volume is so well packed with introductory and appended material rounding out the context of the voyage, and Dr. Beaglehole has handled with such scholarly skill the two holographic versions of Cook's journal plus various fragments, that we at last have at hand the critical and definitive account of one of history's greatest ventures into the unknown. Considering Cook's accomplishments as part of the history of science, it is well to be reminded that just as important for the future—from his time onward—as what he discovered was how he went about it. Cook's voyages succeeded through a combination of imaginative concept, intelligent planning, masterful seamanship, regard for the welfare of all hands, courage, and devotion to the pursuit of objective truth that had never before been seen.

The gift list

Journey Through the Orient. Text and photographs by Martin Hürlimann. Introduction by Sacheverell Sitwell. A Studio Book. The Viking Press, New York. 1959. 340 pp., 223 gravure illus. with 41 in full color. $15.00.

The Lebanon–Pakistan–India–Hong Kong–China–Japan–Thailand: would it be possible to conjure up an array of geographical areas richer with connotations of color, the confluence of ancient and modern in art and architecture, the juxtaposition of opulence and squalor, and the full gamut of teeming human activity? All these places and every facet of their human culture are within the compass of this *Journey Through the Orient* in the post-war period by a cultured Swiss widely recognized for his talent with a lens, who henceforth must be equally respected for the acuity of his pen. Mr. Hürlimann is wholly preoccupied with humanity; this is an exposition of the observable life history of half the people on the earth as they live it in one seventh of its land area. The authors and the reader with him cannot escape—nor can any thoughtful traveler escape—the obvious implications for the world's future in any such massive concentration of our species. But Hürlimann's philosophizing is largely reserved for a final chapter. The book is to be enjoyed for its overflowing gallery of superb photographs interspersed with a compelling travel narrative by a man with wide open eyes, ears, and mind.

Utamaro: Colour Prints and Paintings. By J. Hillier. Phaidon Publishers, Inc. Distributed by New York Graphic Society, Greenwich, Connecticut. [1961.] 161 pp., 17 full color and 109 halftone illustrations. $12.50.

Although Utamaro, among Japan's great woodcut artists, is known to the world mainly for his marvelous revelations of the *demi-monde* of late 18th century Edo—the most exquisite portrayals of the "flower and willow" world of the geisha and the theater ever put on paper—he is notable too for his excursions into realms of nature. For this sophisticated limner of the life of courtesans could also depict in faithful detail and with equal artistry that of a cicada, a Japan wren, or a bivalve on the seashore. There is *A Picture Book of Selected Insects*; a book which is probably not to be considered as natural history, primarily, entitled *One Hundred Birds Compared in Humorous Ditties*; and an album, with poetical text, *Gifts of the Ebb-Tide*. None of these are exactly nature-lovers' handbooks, to be sure; but on the last the present author quotes J. J. O'Brien Sexton, "whose word on such matters is to be respected," as saying: "'From a technical point of view, it is in my opinion, the finest example of wood-engraving and colour-printing that the world has ever seen.'" From any point of view, this *Utamaro* is, for an art lover if not for a nature enthusiast, one of the choicest gift books imaginable.

The Sunset Cook Book: *Food with a Gourmet Touch.* By the Sunset Editorial Staff: Annabel Post, Helen Evans Brown, Kay Hillyard, Ruth B. Lane, Emily Chase Leistner, Janeth Nix, Lou Pappas. Editorial supervision: Dorothy N. Krell. Lane Book Company, Menlo Park, California. 1960. 216 pp., illus. in line and color. $8.50.

Analysis of the contents of a cook book—experimentally, of course—comes legitimately under the heading of scientific

study of the feeding habits of the primate species *Homo sapiens*. I have found this a most congenial area of scholarly investigation, and I have yet to discover a more inviting and stimulating text than this one by the Home Economics faculty on the Menlo Park campus. My review of the work has been so long in preparation because of the necessity for intensive and unhurried laboratory study before committing my observations to print. Moreover it has been difficult to pry the text out of the floured hands of my own chief lab technician. You should be advised forthwith to ignore this manual if you are not of the cheese-stuffed kumquat–cioppino–quick sukiyaki–schweinspfeffer–Hangtown pie–green rice in canna leaves–yams Cointreau–roadside smorgasbord school of gastronomic thought. But if you are experiment-minded, or have someone on your Christmas list who is equally at home in the culinary lab, then this treatise designed with manifest gusto by Adrian Wilson and handsomely produced throughout is the perfect item.

Good work, neighbor

The Living Land: *An Account of the Natural Resources of British Columbia.* By Roderick Haig-Brown. Produced by the British Columbia Natural Resources Conference. Published by William Morrow and Company, New York. 1961. 269 pp., 24 pp. of full-color illustrations, numerous halftone and line figures, 30x30" folded full-color map in back cover pocket. $12.50.

Once in a while a book comes to hand which is either an outstanding example of a not uncommon kind, or is something both unusually fine and quite uncommon in kind. Such a book commands attention. *The Living Land* is—to dismiss the least important fact first—a beautiful book, designed by Robert R. Reid of Vancouver, B.C. and printed by that city's Evergreen Press Limited on British Columbia paper. The fact of importance is that *The Living Land* is a kind of non-technical but fully authoritative natural resources exposition which should exist in book form for every state, province, or well defined geographical region. A book such as this (with its 27 chapters grouped in 10 parts: The Frame of the Land; Basic Resources; Forest Resources; Agriculture; Energy; Commercial Fisheries; Mining; Recreation; Some Incidental Matters [pollution, transportation]; People) could, if widely read, be of enormous help to the various civic agencies charged with administering resources and solving problems, because those who read it would constitute a better informed public, more likely to give their officials due cooperation and constructive criticism. To be specially commended is Haig-Brown's chapter "Conservation Defined"—a first-rate statement of principles.

LIFE Nature Library

The Sea. By Leonard Engel and The Editors of *Life*. Time Incorporated, New York. 1961. 190 pp., profusely illustrated in color, halftone, and line. $3.95 (subscription price).

The Forest. By Peter Farb and The Editors of *Life*. Time Incorporated, New York. 1961. 192 pp., profusely illustrated in color, halftone, and line. $3.95 (subscription price).

Launched with a lavish prospectus and much fanfare early in the year, the *Life Nature Library* has begun to materialize with its first two numbers, *The Sea* and *The Forest*. The prospectus promised great things, and I think that Editor Maitland Edey and his staff have come through quite handsomely with these first two numbers. Texts are by competent science writers; generally, they are more likely to produce readable copy for the everyday reader than working scientists are—at least, that seems to be the theory. Happily, however, there are some topflight scientists who can also write, and the publishers of this series have availed themselves of one such for *The Desert* volume now in preparation—Dr. A. Starker Leopold, President of the California Academy of Sciences, University of California professor of zoology, and an associate editor of this magazine. Formatwise, these books are, as we might expect, *Life*-like pages in hard covers, perhaps somewhat streamlined or refined. The printing is good, on the whole, but with considerable variation in the fidelity of the many full-color photographs. Color art work, like Rudolph Freund's "Bottom Community" and the splendid quarter-sphere ocean bottom charts in *The Sea*, or the prismatic "Leaf Structure" and "How a Tree Trunk Grows" spreads in *The Forest*, for some reason comes off best. Color photos that seem to me the best reproduced are, in *The Sea*, the gooseneck barnacles (p. 21) and the "bloody good" pilot whale slaughter scene (p. 166); and in *The Forest*, the moccasin flower (p. 18), the monarch butterfly (p. 32), twisted birches (p. 56), and the exceptional rain forest floor double-pager (82–83)—a difficult one at best. All in all, I think series subscribers are getting their money's worth, and then some.

Perennial adventurer

Plant Hunters in the Andes. By T. Harper Goodspeed. University of California Press, Berkeley and Los Angeles. 1961. 378 pp., 58 photographs, endpaper maps. $7.50.

Twenty years after its original publication, Professor Goodspeed's classic of exploration for science appears in a new and expanded edition—testimony to the durability of both the book and its plant hunting author. In six expeditions into the Andean regions from Colombia to Chile and Argentina, with asides to Uruguay and the Juan Fernandez Islands of Robinson Crusoe, his chief mission in life being an exhaustive search for the wild origins and relations of the important genus *Nicotiana* (without whose Nightshade family we would not have the potato, tomato, or the pepper, let alone *tabacum*), this indestructible botanist and his many colleagues in the field had more adventures and close calls than Crusoe ever dreamed of. They prove that being an all-out field botanist is a man's job (with due respect to Alice Eastwood's memory)—it's more than picking buttercups in gentle meadows. Let a new generation of young aspirants read this robust narrative before they turn noses up or thumbs down. D.G.K.

Red herring and other fishes

Sciences in Communist China. Edited by Sidney H. Gould, American Association for the Advancement of Science, Washington, D.C. 1961. xii + 872 pp., text figs., $14.00.

This volume contains much of the material presented in a symposium of the American Association for the Advancement of Science in December 1960. The contributors are for the most part of Chinese origin, and thousands of published contributions in all major fields of science up to 1960 were examined and evaluated. Since 1959, official policy prohibits the sending of scientific publications out of China, and it is difficult to know what is actually being done. The suggested reason for the embargo is the shortage of paper, but one suspected reason is that things are not progressing as well as it was hoped. Whatever the cause, this may be the last survey of modern Chinese science for some time. The authors agree that for the most part Chinese scientists are behind in basic research, in part because of the pragmatic policies of the government and its major scientific body, the Academy

of Sciences, but perhaps more because of the shortage of scientists. Again and again we find that leaders in various fields of science hold American University degrees, with English as their preferred foreign language, and again and again we find that young people are being sent to Russia for training. Whatever we may think of the political implications, the burden that this shift to the Russian orbit will place on international communication and understanding is formidable, and will long be felt as one of the most unnecessary fringe detriments of our preesnt China policy. J. W. H.

The Salmon. By J. W. Jones, The New Naturalist, Monograph 16, Harper & Brothers, New York. 1959. xvi + 192 pp., 27 black-and-white photographs, 24 diagrams. $4.00.

Although written by a Welshman about the Atlantic salmon, especially as known in Britain, this book will be of interest to all those who study or fish for salmon in any part of the world, since those parts dealing with general biology include consideration of the Pacific salmon as well, although there is not much about the sea life of Pacific salmon. It is a well written, temperate book, illustrated with some remarkable photographs of salmon in action on the redds, taken through the glass walls of a diverted stream. There is an excellent bibliography. This book is a distinguished addition to the vast literature on salmon. J. W. H.

PAPERBACKS AND PLATTERS

(Continued from page 27)

species. However, it is an especially attractive combination of text, photos in color and black-and-white, and a record excellent for children.

Frogs and Toads

Voices of the Night. Recorded by A. A. Allen and P. P. Kellogg. Cornell University Records. 33⅓ RPM; 34 species; $6.75.

Sounds of North American Frogs. Recorded by Charles M. Bogert. Folkways Records, 33⅓ RPM; $5.95. 92 examples are used to illustrate the biological significance of frog voices.

Mammals (mostly)

Sounds of Animals. Recorded by Nicholas Collias and Arthur M. Greenhall. Folkways Records. 33⅓ RPM; $5.95. 10 zoo animals and 3 farm animals are represented here.

Animal Language. Recording produced by Vinson Brown with collaborators. Sounds Unlimited. 33⅓ RPM; $5.95. 38 voices of farm and zoo animals, birds, frog, rattlesnake, termite and child.

Insects

Sounds of Insects. Recorded by A. T. Gaul. Folkways Records. 33⅓ RPM; 38 species; $5.95.

The Songs of Insects. Recorded by Richard D. Alexander and Donald J. Borror. Cornell University Records. 40 species; $7.75.

Underwater Sounds

Sounds of the Sea. Recorded by the Naval Research Laboratory. Folkways Records. 33⅓ RPM; 28 sounds; $5.95.

Sounds of Sea Animals. Recorded by W. N. Kellogg. Folkways Records. 33⅓ RPM; 10 species, 32 recordings; $5.95. Included are shrimp, fishes, manatee, and porpoises.

Miscellaneous

Sounds of the American Southwest. Recorded by Charles M. Bogert. Folkways Records. 33⅓ RPM; $5.95. Included are the sounds of 42 birds, mammals, amphibians, snakes, insects, and a storm or two.

Sounds of a Tropical Rain Forest in America. Recorded by P. P. Kellogg, A. A. Allen, and others. Folkways Records. 33⅓ RPM; $5.95. Dawn to dusk in the jungles with insects, birds, monkeys, and amphibians.

Jungle Sounds. Recorded by P. P. Kellogg, A. A. Allen and D. G. Allen. Cornell University Records. 78 RPM; $5.00. Dawn to dusk in the dry season and a night in the jungle; both recorded on Barro Colorado Island.

A Day at Flores Morades. Recorded by W. W. H. Gunn. Federation of Ontario Naturalists. 33⅓ RPM; $5.95. Birds, monkeys, insects, sound effects, and some native folk music from Venezuela. This record is a favorite with the youngsters.

The most useful record for making a serious study of nature sounds is *Animal Sounds and Communication.* Edited by P. P. Kellogg. American Institute of Biological Science. 33⅓ RPM. The record is accompanied by a book with the same title, edited by W. E. Lanyon and W. N. Tavolga with 443 pages. The price is $9.50 for the record and book. The volume and recording represent the proceedings of a symposium organized by the Section of Animal Behavior and Sociobiology, Ecological Society of America and American Society of Zoologists, held at the AIBS meetings at Indiana University in 1958. The voices of birds, chickens, insects, fishes, and frogs are presented and analyzed.

Bighorn or mountain sheep *(Ovis canadensis).* (Drawing by Edward Bierly, from *Mammals of the Southwest Mountains and Mesas*)

(Continued from page 26)

Popular Series of the Southwestern Monuments Association, Globe, Arizona:

Mammals of the Southwest Mountains and Mesas. By George Olin. Illustrated by Edward Bierly. 126 pp. $2.00.

Mammals of the Southwest Deserts. By George Olin. Illustrated by Jerry Cannon. 112 pp. $1.00.

Poisonous Dwellers of the Desert. By Natt N. Dodge. 37 pp. 60¢.

Flowers of the Southwest Mountains. By Leslie P. Arnberger. Illustrated by Jeanne R. Janish. 112 pp. $1.00.

Flowers of the Southwest Mesas. By Pauline M. Patraw. Illustrated by Jeanne R. Janish. 112 pp. $1.00.

Flowers of the Southwest Deserts. By Natt N. Dodge. Illustrated by Jeanne R. Janish. 112 pp. $1.00.

This series consists of remarkably attractive books with

a wealth of information about the plants and animals of our American Southwest.

The Natural History Library. Doubleday Anchor, published in coöperation with the American Museum of Natural History:

In addition to the four titles included in our $25 bookshelf the following are also now available:

The Pacific Islands. By Douglas L. Oliver. 456 pp. $1.45.

The Ocean Island: Inagua. By Gilbert C. Klingel. 415 pp. $1.45.

White Waters and Black. By Gordon MacCreagh. 335 pp. $1.45.

John and William Bartram's America. Edited by Helen Gere Cruickshank. 378 pp. $1.45.

From Fish to Philosopher. By Homer W. Smith. 293 pp. $1.45.

Dwellers in Darkness. By S. H. Skaife. 180 pp. 95¢.

The Wandering Albatross. By William Jameson. 131 pp. 95¢.

Shearwaters. By R. M. Lockley. 256 pp. $1.25.

Horses. By George Gaylord Simpson. 323 pp. $1.45.

These books were all originally published in hard cover editions. In most cases a foreword or preface by an American Museum of National History staff member and a biography of the author are included.

Prentice-Hall Foundations of Modern Biology Series:

In addition to the three titles included in our $25 bookshelf the following are also now available:

Heredity. By David M. Bonner.

The Cell. By Carl P. Swanson.

Cellular Physiology and Biochemistry. By William D. McElroy.

Adaptation. By Bruce Wallace and Adrian M. Srb.

Animal Growth and Development. By Maurice Sussman.

Animal Physiology. By Knut Schmidt-Nielsen.

Animal Diversity. By Earl D. Hanson.

The Life of the Green Plant. By Arthur W. Galston.

Each volume is approximately 116 pages. Priced $1.50.

The Science Library: Harper Torchbooks.

This series now consists of some 42 volumes of which the latest title at hand is:

The Social Insects. By O. W. Richards. 217 pp. $1.50.

Dover Books:

This publisher has reprinted many books of great interest and value to the naturalist. Among the recently issued titles are:

The Orientation of Animals. By Gottfried S. Fraenkel and Donald L. Gunn. 376 pp. $2.00.

The Common Spiders of the United States. By James H. Emerton. 227 pp. $1.35.

Manual of the Trees of North America. By Charles Sprague Sargent. (In two volumes.) 910 pp. $4.00.

Audubon and His Journals. By John James Audubon. Edited by Maria Audubon. (In two volumes.) 1086 pp. $4.00.

Miscellaneous:

The Mammoth Lakes Sierra: A Handbook for Roadside and Trail. By Genny Schumacher, et al. The Sierra Club. 145 pp. $2.45.

The National Parks. By Freeman Tilden. Alfred A. Knopf. 326 pp. $1.25.

DESERT WILDLIFE

Edmund C. Jaeger

A complete revision of the author's earlier "Our Desert Neighbors," this is virtually a new work. It contains 8 new chapters, much new material in existing chapters, and many additional photographs and drawings. The author's previous books have received the highest praise: "A book by Edmund Jaeger is always a delight."—*AMERICAN SCIENTIST*, "Jaeger knows more about the elusive life of the American deserts than anyone writing today."—*CHICAGO TRIBUNE*, "The name of Edmund C. Jaeger on the title page of any volume is adequate certification of its excellence."—*QUARTERLY REVIEW OF BIOLOGY*. $5.95

At your bookstore

STANFORD UNIVERSITY PRESS

Index to *Pacific Discovery*: Volume XIV, 1961

ABBOTT, ISABELLA, *2* 33
Adaptive radiation (in Hawaiian birds), *5* 6 *ff.*

ACADEMICALLY SPEAKING (department): *1* 33, *2* 33, *3* 33, *4* 33, *5* 37, *6* 37

Agassiz, Louis, in San Francisco, *6* 22-25
AGASSIZ, LOUIS (speech to California Academy of Sciences), *6* 25
Albatrosses, *2* 21-24, *3* 4-5,8-9
ALEXANDER, JOSEPHINE, *1* 18-24
Algae, marine, *1* 13-17
ALLEN, MRS. HARRY, *3* 32
Animal life underground, *2* 9-14
Arizona-Sonora Desert Museum, *2* 9-14

ARTICLES:

Ancient Art in the Wilderness. CAMPBELL GRANT, *4* 12-19
Arizona-Sonora Underground. ANNETTE R. & HIRAM L. PARENT, *2* 9-14
Climate by the Mile. DAVID I. BLUMENSTOCK, *5* 3-4
Climate, Landscape, and Man in Southern California. MALCOLM F. FARMER, *4* 20-24
Cruise of the Hassler, *The.* JOSEPH L. PARKHURST, JR., *6* 22-25, including:
"Welcome to Agassiz, A—San Francisco: September 1872" (verse), 23
"Academy of Science. Professor Agassiz Makes a Speech" (excerpt), 25
Dry Falls: Skeleton from the Columbia's Past. CECIL M. OUELLETTE, *1* 24-25
Floral Footnote: Foster Botanical Garden. PAUL R. WEISSICH, *5* 14-15
"Grassroots Oceanography." JOSEPHINE ALEXANDER, *1* 18-24
Great Victoria Desert, The. V. L. SERVENTY, *6* 2-11
Green Hawaii: Past, Present, and Future of an Island Flora. OTTO & ISA DEGENER, *5* 15-17
Hawaii's Birds—Birth and Death of an Island Biota. RICHARD E. WARNER, *5* 6-13
Last of the Lacandones. GERTRUDE DUBY, *4* 2-11
Living Monuments. SAMUEL A. WRIGHT, JR., *6* 12-16
Many a Drop to Drink: Water for Island Thirst. HUGH LYTLE, *5* 5
Millennium of Hawaiian Discovery, A. ALEXANDER SPOEHR & KENNETH P. EMORY, *5* 18-21
Nature Sang to Him Night and Day. HAROLD L. MONROE, *3* 11-12
Ra'ivavae—"High Island" (From the book *Ra'ivavae*). DONALD MARSHALL, *2* 2-8
St. Hilary's Garden. Photo-Story by ANNA-JEAN COLE, *2* 15-19
Science Goes Fishing: Ichthyology in the Hawaiian Islands. EARL S. HERALD, *5* 26-29
Seaweeds (a photo album), *1* 13-17
Sleep on the Deep. KARL W. KENYON, *3* 22-24
Subantarctic Island. ALFRED M. BAILEY, Part I, *1* 2-12; Part II, *2* 20-25; Part III, *3* 2-10
Trees. Photographs by HENRY H. SHELDON, *6* 17-21
White Dove of the Desert. PHYLLIS W. HEALD. Photographs by WELDON F. HEALD, *3* 20-21
Wright Approach to Natural History, The. Cartoon feature. PATRICIA F. WRIGHT, *3* 31, *4* 31

ASTRONOMY (department):

Great Astronomical Discovery of 1960, The. O. RICHARD NORTON, *3* 25-27
How Red Are the Stars? GEORGE W. BUNTON, *2* 28-29
Mars. GEORGE W. BUNTON, *1* 28-29
Pluto—The Planet Beyond. O. RICHARD NORTON, *6* 28-30
Twilight Around the World. GEORGE W. BUNTON, *5* 32-33
Winds Among the Stars. GEORGE W. BUNTON, *4* 28-29

BAILEY, ALFRED M., *1* 2-12, *2* 20-25, *3* 2-10
BLUMENSTOCK, DAVID I., *5* 3-4

BOOK REVIEWS:

All the Best in the South Pacific, 5 34
Anza-Borrego Desert Guide Book: Southern California's Last Frontier, 3 31
Art of China, The: Spirit and Society, 4 30
Art of the Stone Age, The: Forty Thousand Years of Rock Art, 4 30
Art of the World: Non-European Cultures, the Historical, Sociological and Religious Backgrounds, 4 30
Arts and Crafts of Hawaii, 5 34
Birds of Hawaii, 5 36
Birds of the West, 3 28
Book of the Atom, The, 1 31
Cabins and Vacation Houses, 3 32
Cahuilla Indians, The: The Men Called Master, 4 23
California Spring Wildflowers, 3 28
California Through the Ages: The Geological Story of a Great State, 4 31
Camper's Bible, The, 3 32
Common Plants of the Southern California Mountains, 3 32
Complete Field Guide to American Wildlife—East, Central and North, 2 31
Discovery and Exploration: an Atlas-History of Man's Wanderings, 3 30
Discovery of the Pacific Islands, The, 2 30
Donner Pass, and Those Who Crossed It, 3 32
Exploring Under the Earth, 1 31
Familiar Insects of America, 1 31
Field Guide to Western Birds, A, 3 28
Flora of the Santa Cruz Mountains of California, 3 31
Forbidden Voyage, The, 4 32
Forest, The (LIFE Nature Library), *6* 32
For Fear We Shall Perish: The Story of the Donner Party Disaster, 3 30
Frontier Military Posts of Arizona, 3 32
Galathea Deep Sea Expedition 1950-1952, The, 1 1,31
Great Experiments in Physics, 1 31
Handbook of California Birds, 3 28
Hawaii: A Guide to All the Islands, 3 32
Hawaiian Book, The: Story of Our Island Paradise, 5 35
Hawaii 1961, 5 34
Hawaii, the Aloha State, 5 35
High Sierra: Mountain Wonderland, 3 32
Hive of Bees, A, 1 31
India: Five Thousand Years of Indian Art, 4 30
Indian Art in America: The Arts and Crafts of the North American Indian, 4 19
Indonesia: The Art of an Island Group, 4 30
Journey Through the Orient, 6 31
King of the Mountain Men, 4 30
Living Amphibians of the World, 5 36
Living Fishes of the World, 5 36
Living Laboratory, The, 2 31
Living Land, The: An Account of the Natural Resources of British Columbia, 6 32
Living Sea, The, 1 31
Long Voyage, The, 4 32
Los Angeles: From Mission to Modern City, 3 30
Louis Agassiz: A Life in Science, 6 24
Lower Animals, The: Living Invertebrates of the World, 3 31
Man's Journey Through Time, 4 31
Maya, The: Indians of Central America, 4 11
Mayan Terracottas, 4 11
Meaning of Wilderness to Science, The: Proceedings, Sixth Biennial Wilderness Conference, 2 30
Meet the Southwest Deserts, 3 31
Mediterranean Lands, The, 3 30
Men and Moments in the History of Science, 1 31
Mexico, 3 30
My Valley in the Sky, 4 31
Nature: Earth, Plants, Animals, 3 31
Nature of the Universe, The, 1 31
New Age in Physics, The, 1 31
Nine Planets, 1 31
Ocean of Air, The, 5 35
Oceanography, 5 36
101 Simple Experiments With Insects, 2 31
Orion Book of Evolution, The, 4 30
Orion Book of the Sky, The, 4 30
Orion Book of the Sun, The, 4 30
Orion Book of Time, The, 4 30
Paperback series listed:
Dover Books, *6* 34
Foundations of Modern Biology (Prentice-Hall), *6* 34
Natural History Library, The (Doubleday Anchor), *6* 34
Popular Series (Southwestern Monuments Association), *6* 33
Science Education Series (Fearon), *1* 26
Science Library, The (Harper Torchbooks), *6* 34
Peculiar Piece of Desert, A, 4 31
Plant Hunters in the Andes, 6 32
Ra'ivavae: An Expedition to the Most Fascinating and Mysterious Island in Polynesia, 2 8
Salmon, The, 6 33
Science: Chemistry, Physics, Astronomy, 1 31
Sciences in Communist China, 6 32
Sea, The (LIFE Nature Library), 6 32
Sea Around Us, The, 2 30
Searchers of the Sea: Pioneers of Oceanography, 4 1,32
Sea Was Kind, The, 4 32
1600 Years Under the Sea, 4 1,32
Skid Road: An Informal Portrait of Seattle, 3 30
Spectrum: The World of Science, 1 31
Sunset Cook Book, The: Food with a Gourmet Touch, 6 31
Sunset Western Campsite Directory, 3 32
Trailer Travel Here and Abroad, 3 30
Utamaro: Colour Prints and Paintings, 6 31
Voyage of the Resolution *and* Adventure, *1772-1775, The, 6* 31
What Makes a Scientist? 1 31
Wilderness: The Discovery of a Continent of Wonder, 3 30

Windows in the Woods, *2* 31
Words of the Earth, *2* 29

Books, paperback, in natural sciences, *6* 26
BOWMAN, ROBERT I., *5* 37
BUNTON, GEORGE W., *1* 28-29, *2* 28-29, *4* 28-29, *5* 32-33

Campbell Island (N.Z.), *1* 2-12, *2* 20-25, *3* 2-10
CARSON, MEARL F., *4* 31
Climate in relation to land and life, *4* 20-24
CLOSE, MRS. FRANKLIN D., *1* 32
COLE, ANNA-JEAN, *2* 15-19
COLLINS, GEORGE L., *4* 26-27
Color of stars, *2* 28
Columbia River, Dry Falls (Wash.), *1* 24-25
Conservation, *2* 1, *6* 1

CONSERVATION (department):
Nene: Future for a State Bird. DAVID H. WOODSIDE, *5* 24-26
Point Reyes Peninsula Has Been Called "An Island in Time," The. Photographs by PHILIP HYDE, *3* 14-19
UN, IUCN, and the World's National Parks. DORIS F. LEONARD & GEORGE L. COLLINS, *4* 26-27

DAWSON, GOLDIE P., *3* 32
DEGENER, OTTO & ISA, *5* 15-17
Desert, Great Victoria (Australia), *6* 2-11
Desert plants, *2* 27
Designs in nature, *1* 33
DE VOTO, BERNARD (quoted), *6* 1
Drepanididae (bird family, Hawaii), *5* 6-13
DUBY, GERTRUDE, *4* 2-11

East-West Center (Univ. of Hawaii), *5* 1-2

EDITORIALS:
"Above All Nations Is Humanity." THOMAS NICKERSON, *5* 1-2
Adventure of the Sea, The (Reviews), *4* 1,32
Conservation Can't Wait! *2* 1
Galathea *and the* Bios Pacifica, *The*, *1* 1
More Recruits for Conservation, *6* 1
On Rediscovering the Earth, *3* 1
EMORY, KENNETH P., *5* 20-21
Exploration of the earth, *3* 1-30

FARMER, MALCOLM F., *4* 20-23
FARWELL, DENISE, *2* 32

FOCUS ON NATURE (department):
1 26-27, *2* 26-27, *3* 28-29, *4* 24-25, *5* 30-31, *6* 26-27
Foster Botanical Garden (Hawaii), *5* 14-15

FROM THE READER (department):
1 32, *2* 32, *3* 32

Galápagos Islands, research problems, *5* 37
Ghyben-Herzberg lens (hydrology), *5* 5
GRANT CAMPBELL, *4* 12-19

Hassler, research vessel, *6* 22-23
Hawaii, archeology, *5* 20-21
birds, *5* 6-13
climate, *5* 3-4
discovery, *5* 18-20
fishes, collecting and research, *5* 26-29
flora, *5* 14-17
nature study, *5* 30-31
special issue, *5*
state bird (nene), *5* 24-26
HEALD, PHYLLIS W., *3* 20-21
HEALD, WELDON F. (photographs), *3* 30-21
HEDGPETH, JOEL W., *5* 36, *6* 32-33
HERALD, EARL S., *5* 26-29
HERRE, ALBERT W., *1* 32
HUEY, LAURENCE M., *3* 13-14
Hummingbird, Anna, *1* 27
HYDE, PHILIP, *3* 14-19

ILLUSTRATIONS:
Agassiz, Louis (photographs), *6* 24
Albatross, royal, *1* 9, *2* 20,21, *3* 4
sooty, *2* 23
wandering, *3* 5
Brodiaea spp., *2* 17,18
Buckwheat (*Eriogonum caninum*), *2* 15
Bullfrog (*Rana catesbiana*), *6* 26
Cacomistl (ring-tailed cat), *2* cover
Cactus, California barrel (*Echinocactus acanthodes*), *2* 27
Century plant (*Agave* sp.), *2* 27
Cholla, jumping (*Opuntia Bigelovi*), *2* 27
Cormorant, double-crested, *4* 25
Desert, scenes (Australia), *6* 2,3,5,7,9-11
Dogwood (large tree, in flower), *6* 19
Dry Falls, Columbia River (Wash.), *1* 25
Hawaiian artifacts, life (pre-European), *5* 18-21
Honeycreeper, Kauai akialoa (*Hemignathus procerus*), *5* 7
ou (*Psittirostra psittacea*), *5* 7
Honeyeater, Hawaii oo (*Acrulocercus nobilis*), *5* 6
Hummingbird, Anna, *1* 27
Indian life (Lacandon, Mexico), *4* 3-11
Joshua tree (Yucca brevifolia), *2* 27
Katydid, *6* 26
Lily, California leopard (*Lilium pardalinum*), *2* 17
Mars, planet (photograph, drawings), *1* 28-29
Mesquite, honey (*Prosopis juliaflora*), *2* 27
screw bean (*Prosopis pubescens*), *2* 27
Mission San Xavier del Bac (Ariz.), *3* 20-21
Moth, sphinx, *1* 27, *4* 25
Mountain devil (Australian lizard), *6* 10
Nene (Hawaiian goose, state bird), *3* 24-25
Our Lord's candle (*Yucca Whipplei*), *2* 27
Palo verde (*Cercidium floridum*), *2* 27
Penguin, rockhopper, *1* 10-11
Pictographs, Indian (Calif.), *4* cover. 12-19
Pine, western yellow, *6* 17
Pluto, planet (discovery photographs), *6* 29
Point Reyes Peninsula (Calif.), *3* 15-19
Saguaro (*Cereus giganteus*), 2 27
Scales, snake skin, butterfly wing (magnified), *1* 33
Scorpion, *4* 25
Seal, elephant, *1* 8, *3* 3,6,7
Sea otter, *1* 22,24
Seaweeds (various species), *1* 13-17
Sidewinder (rattlesnake), *3* 29
Smoke tree (*Dalea spinosa*), *2* 27
Sun, with flares, *4* 28
Tarantula, *4* 25
Ti plant (*Cordyline terminalis*), *5* 31
Zigadene (*Zigadenus fontanus*), *2* 16
Indian art (California), *4* 12-19
life (so. California), *4* 20-24

Kelley, Don Greame, *6* 37
KELLEY, DON GREAME, *1* fac.1,1,31-32, *2* fac.1, 8,29-33, *3* fac.1,1,30-32, *4* fac.1,1,11,19, 30-32, *5* fac.1,34-36, *6* fac.1,24-25,31-32
KENYON, KARL W., *3* 22-24

Lacandon Indians (Mexico), *4* 2-11
Lark, horned, unusual nesting-place, *3* 13-14
LEONARD, DORIS, *4* 26-27
LYTLE, HUGH, *5* 5

MAPS:
Campbell Island (N.Z.), *1* 2-3
Dry Falls, Columbia River (Wash.), *1* 24
Lacandon Indian area (Mexico), *4* 10
Mars (Avigliano, 1954), *1* 30
Ra'ivavae (Austral Is., Pacific), *2* 5
Marine biology, teaching, *1* 18-24
MARSHALL, DONALD, *2* 2-8
Mars, planet, *1* 28-29
MCCLINTOCK, ELIZABETH, *3* 31
MILLER, ROBERT C., *2* 1, *6* 1
MONROE, HAROLD L., *3* 11-12
Moth, bear sphinx, *1* 26-27
Natural area conservation, *2* 26
Nature study in summer, *4* 24-25
NICKERSON, THOMAS, *5* 1-2
NORTON, O. RICHARD, *1* 30, *2* 29, *3* 25-27, *4* 29, *5* 33, *6* 28-30

Oceanography, *1* 1,18-24, *4* 1, *6* 22
OUELLETTE, CECIL M., *1* 24-25

Pacific Science Congress, *4* 33
PARENT, ANNETTE R. & HIRAM L., *2* 9-14
PARKHURST, JOSEPH L., JR., *6* 22-25
Parks, national, World Conference, *4* 26-27
Pictographs, Indian (California), *4* 12-19
Pine, bristlecone, *6* 12-16
Pluto, planet, *6* 28-30
Point Reyes Peninsula (Calif.), *3* 14-19

Radio astronomy, discoveries, *3* 25-26
Ra'ivavae Island (Pacific), *2* 2-8

RECORD REVIEWS:
Animal Language, *6* 33
Animal Sounds and Communications, *6* 33
Bird Songs in Your Garden, *6* 27
Dawn in a Duck Blind: A Guide to the Calls of Waterfowl, *6* 27
Day at Flores Morades, A, *6* 33
Field Guide to Bird Songs, A, *6* 27
Jungle Sounds, *6* 33
Mockingbird Sings, The, *6* 27
Songs of Insects, The, *6* 33
Songs of Spring (and other titles), *6* 27
Sounds of Animals, *6* 33
Sounds of a Tropical Rain Forest in America, *6* 33
Sounds of Insects, *6* 33
Sounds of North American Frogs, *6* 33
Sounds of Sea Animals, *6* 33
Sounds of the American Southwest, *6* 33
Sounds of the Sea, *6* 33
Voices in the Night, *6* 33
Western Bird Songs, *6* 27
Western Bird Songs of Dooryard, Field and Forest, *6* 27

Reptile study, *3* 29
RICHARDSON, HAL, *1* 33, *2* 33, *3* 33, *4* 33, *6* 37

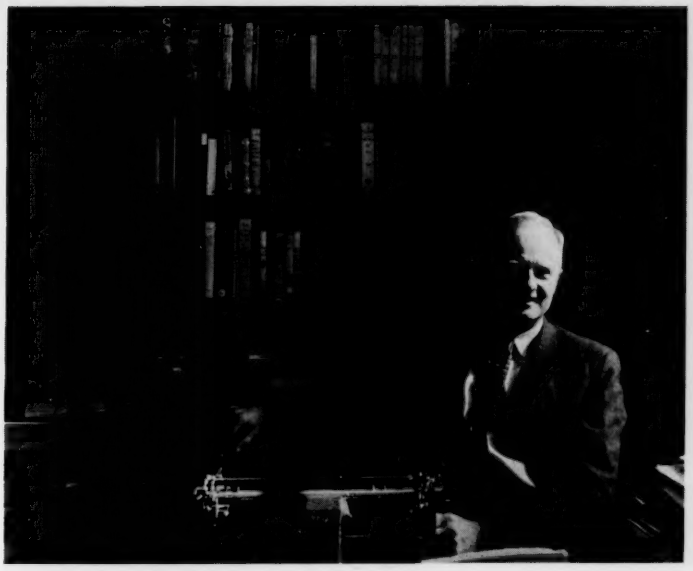
San Xavier del Bac Mission (Ariz.), *3* 20-21

SCIENCE LOOKS INTO IT (department):
Avian Adaptation to the Jet Age. LAURENCE M. HUEY, *3* 13-14
Seal, elephant, *3* 2-3,6-7
SERVENTY, V. L., *6* 2-11
Sleep of animals on open sea, *3* 22-24
SMITH, ARTHUR C., *1* 26-27, *2* 26-27, *3* 28-29, *4* 24-25, *5* 30-31, *6* 26-27
Sounds in nature (recordings listed), *6* 27,33
SPOEHR, ALEXANDER, *5* 18-20
Stars, color, *2* 28
gaseous eruptions, *4* 28-29
spectra, *3* 25-26
Steinhart Aquarium, renovation, *2* 33
Stephens, Frank, *3* 11-12
Student Section (Calif. Acad. of Sci.), *3* 33

Trees (photographs), *6* 17-21
Twilight, *5* 32-33

WARNER, RICHARD E., *5* 6-13
Water supply, Honolulu, *5* 5
WEISSICH, PAUL R., *5* 14-15
Wildflowers (Marin Co., Calif.), *2* 15-19
WOLFF, TORBEN, *3* 32
WOODSIDE, DAVID H., *5* 24-26
WRIGHT, PATRICIA F., *3* 31, *4* 31
WRIGHT, SAMUEL A., JR., *6* 12-16

academically speaking



FOURTEEN YEARS and eighty-four issues from its beginning, the man who has been primarily responsible for the magazine you are now holding in your hands is reluctantly, but with pride, relinquishing his position. With this issue of *Pacific Discovery*, Don Greame Kelley takes leave of it and the Academy to go on to new challenges and separate horizons. Those readers who know the magazine well will realize exactly what this means, for his creative hallmark has been stamped on each and every copy of *PD*, and his diversified talents as editor, art director, layout man, legman, and what have you, will not be easy to replace.

Back in July of 1947, Don came to the Academy on a part-time basis. His job: to create a brand-new magazine of science, an opportunity not likely to occur during a lifetime but one exciting and remarkable enough to delight any artist, writer, or scientific scholar. Being a bit of all these, Don was admirably equipped for the job.

The first editorial board consisted of Robert C. Miller, Director of the Academy, Wilbert M. Chapman, then Curator of Fishes, John L. Kask, then Curator of Aquatic Biology, A. Starker Leopold, then an Assistant Professor at the University of California and now President of the Academy, Ira L. Wiggins, Professor of Botany and Director of the Natural History Museum at Stanford, now ex-President of the Academy and a member of the Board of Trustees, Robert T. Orr, currently Curator of Birds and Mammals, and Edward S. Ross, now Curator of Insects.

First things coming first, the initial problem was the title. The single word "Discovery" appealed to all, but it was—and is—the title of a British science journal. Finally the combination of "Pacific" and "Discovery" was arrived at. When considered with its chosen subtitle, "A Journal of Nature and Man in the Pacific World," this seemed to do the trick, and that is how *PD* got its name.

Then came the problem of choosing the first cover picture. "Sailing ships have always represented discovery to me," Don reminisced. "So I looked at hundreds of pictures and finally came across that picture of the square-rigger which seemed to be heading out across the Pacific. I like to feel we've been sailing ever since!"

The first print order was 3,000 copies. Fourteen volumes later it is 7,000. The thickest issue in terms of pages and largest printing was the Morrison Planetarium issue (November-December 1952). The issue devoted solely to Hawaii (September-October 1961) was the next largest print order. All of the covers have been in a two-color process except two, when full color photos were used. Don figures that over the years he has personally reviewed approximately 1,000 books in the book review section, and he wants to continue as book editor.

Pacific Discovery has been the recipient of two distinguished awards under Editor Kelley's aegis. In 1952, the American Institute of Graphic Arts gave it a national award for excellence in design, and during the past year, *PD* received a Silver Medal from the committees of the California State Fair for running one of the best magazine stories of the year ("Canoes, Campfires, and Carbon 14," May-June 1960). More satisfying perhaps has been the reader response and the slow but gratifying growth of circulation over the years.

"I just wish it could grow faster," Don went on, "and truly become the top magazine in its field—the leading nature and geographical magazine of the Pacific World. I have every reason to believe that possible. Maybe the change will be good for *PD* and for everyone concerned."

The change for Don Kelley promises to be rewarding and exciting. In November, he becomes Western Regional Director for The Nature Conservancy, a national conservation society, with regional office in Berkeley and national headquarters in Washington, D.C. Don's particular area will be the 13 western states including Alaska and Hawaii, and his purpose to secure, preserve, and manage wild areas, such as the Northern California Coast Range Preserve on the Eel River in Mendocino County.

"It is not easy to leave the Academy after all this time," Don continued. "The attachment is strong, serious, and sentimental. But the prospect of creating living museums of nature in the out-of-doors has a mighty strong appeal. They will not be just to lock up and keep, or for the enjoyment of a few people; they will be needed laboratories for scientific study of the ecology and biology of each type of natural area. So, although I will no longer be on the Academy staff, I'll still be working in the fields of science. And that's a privilege in itself!"

Good-luck, Don, and Godspeed! H. R.

EASY CHAIR COMFORT

LONG RUGGED WEAR

LEVI'S

AMERICA'S FINEST OVERALL

Since 1850

Today we painted some music

It may seem unusual that these youngsters are painting "by ear"... turning music from the classroom radio into colorful pictures. But this is the kind of creativeness the Standard School Broadcast inspires.

Currently, the program's theme is "Music—Passport to the World." Using our listening guide, teachers relate music to geography, history, art, folklore, literature.

This helps children gain insight into the life and culture of the peoples of the world. It leads to better and quicker understanding of both the music and the other studies.

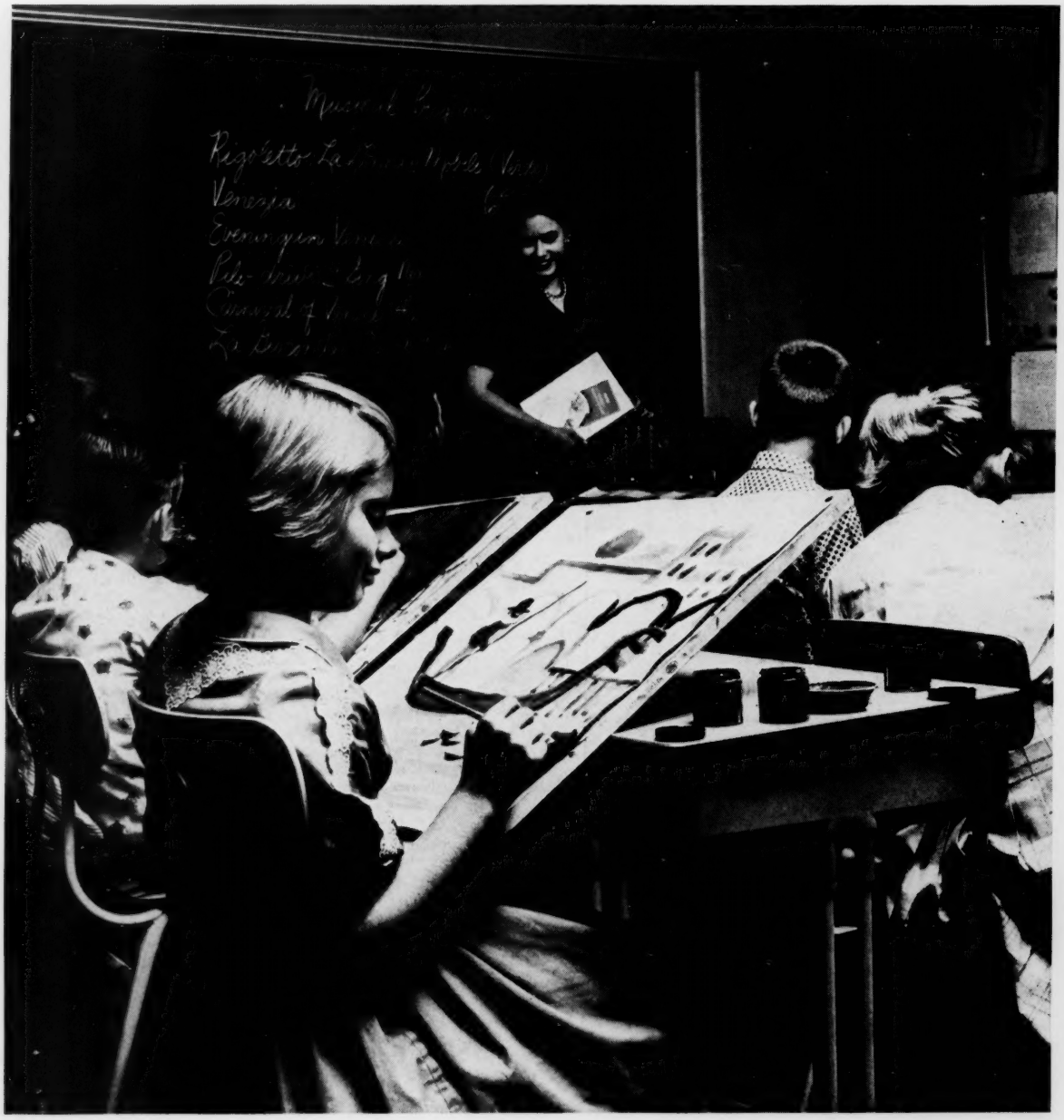
By playing and dramatizing all types of music—symphony to jazz, Thailand dances to Broadway hits—the program adds a new, delightful dimension to learning.

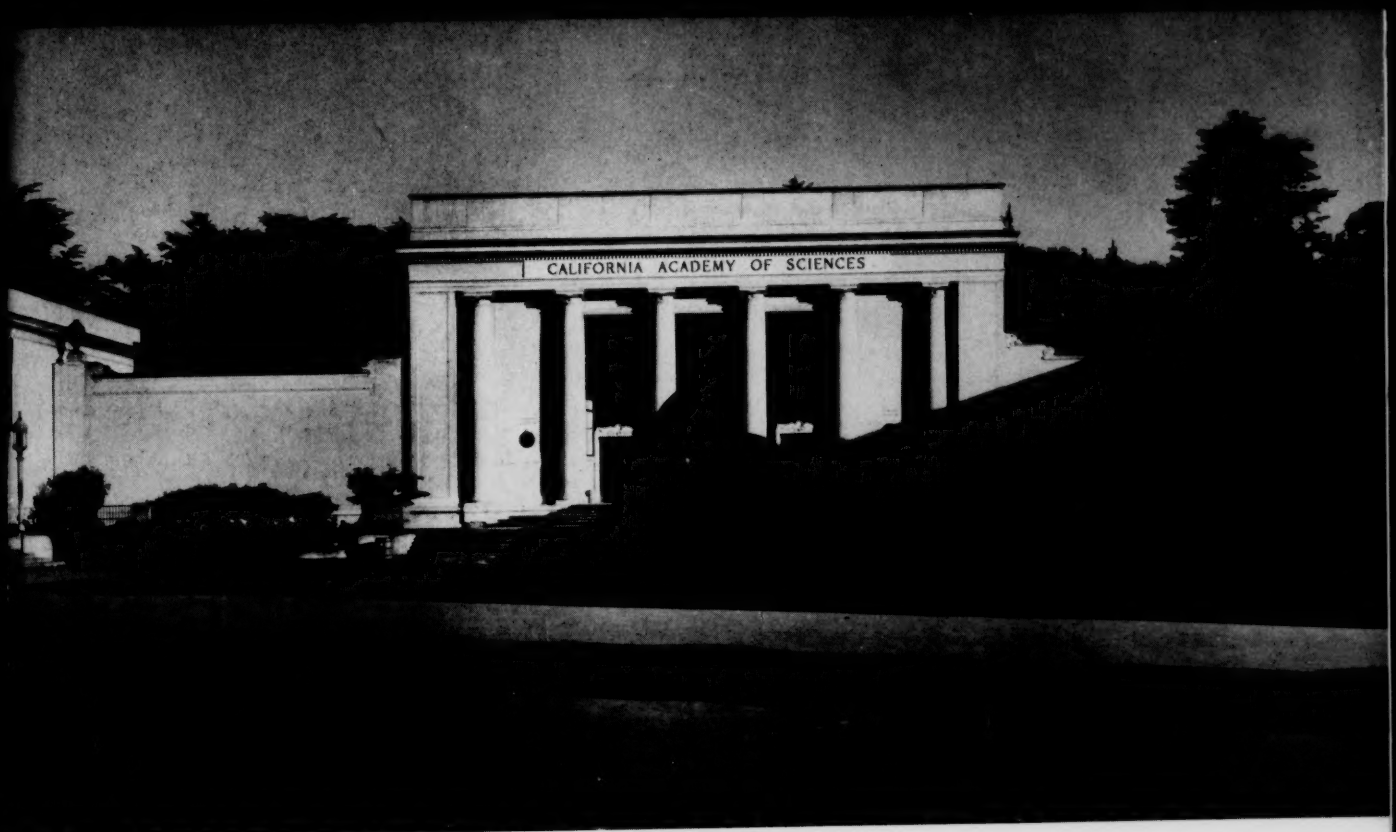
We started this program 33 years ago, never dreaming our listening family would grow to some 2½ million children in their classrooms. Now countless adults, too, have discovered how entertaining and informative the broadcasts are at home.

If you'd like to know why the program has such wide appeal, try tuning in on Thursdays. We think you'll enjoy it, too.

planning ahead to serve you better

STANDARD OIL COMPANY OF CALIFORNIA





CALIFORNIA ACADEMY OF SCIENCES

ANNUAL REPORT

1961

TRUSTEES

DECKER G. MCALLISTER, *Chairman*

J. W. MAILLIARD III, BROOKS WALKER, *Vice-Chairmen*

A. STARKER LEOPOLD, *President* • J. WYATT DURHAM, *Vice-President*

GEORGE STIMMEL,* *Treasurer* • SIEMON W. MULLER, *Secretary*

WILSON MEYER, *Chairman, Finance Program*

KENNETH K. BECHTEL • S. D. BECHTEL, JR. • EUGENE D. BENNETT

V. J. BERGERON • IAN CAMPBELL • VINCENT I. COMPAGNO

MRS. JOSEPH C. FENNELLY • MARCO F. HELLMAN • BARRETT G. HINDES

WILLIAM S. W. KEW* • SIDNEY LIEBES • JAMES K. LOCHEAD • T. S. PETERSEN

MRS. HENRY POTTER RUSSELL • H. P. STEWART

IRA L. WIGGINS • BRAYTON WILBUR

PAUL G. BRISLAWN, *Secretary to the Board*

HONORARY TRUSTEES

BRUCE CORNWALL* • FRANCIS P. FARQUHAR • DANIEL E. KOSHLAND

CHARLES PAGE • DEAN WITTER

* Deceased.

*STAFF**

ROBERT C. MILLER, *Director* • VASHTI F. HAWLEY, *Secretary*

Aquatic Biology (Steinhart Aquarium)
EARL S. HERALD, *Curator*
ROBERT P. DEMPSTER, *Associate Curator*
DONALD A. SIMPSON, *Assistant Curator*†

Astronomy
GEORGE W. BUNTON, *Curator*
O. RICHARD NORTON, *Assistant Curator*
CLAY P. BUTLER, *Research Associate*

Botany
JOHN THOMAS HOWELL, *Curator*
ELIZABETH MCCLINTOCK, *Associate Curator*
MRS. JOHN HARDHAM, *Research Associate*
HANS LESCHKE, *Research Associate*
HENRY M. POLLARD, *Research Associate*
LEWIS S. ROSE, *Research Associate*
ERNEST C. TWISSELMANN, *Research Associate*

Entomology
EDWARD S. ROSS, *Curator*
EDWARD L. KESSEL, *Associate Curator*
HUGH B. LEECH, *Associate Curator*
EDWARD O. ESSIG, *Research Associate*
KENNETH E. FRICK, *Research Associate*
HARRIET E. FRIZZELL, *Research Associate*
J. LINSLEY GRESSITT, *Research Associate*
E. GORTON LINSLEY, *Research Associate*
ROBERT L. USINGER, *Research Associate*
FRANCIS X. WILLIAMS, *Research Associate*

Exhibits
MEARL F. CARSON, *Curator*
TOSHIO ASAEDA, *Associate Curator*
ANSEL E. ADAMS, *Research Associate*

Gem Minerals
CHARLES W. CHESTERMAN, *Honorary Curator*

Geology
G DALLAS HANNA, *Curator*
LEO G. HERTLEIN, *Associate Curator*
CLIFFORD C. CHURCH, *Research Associate*
ALAN J. GALLOWAY, *Research Associate*

Herpetology
ALAN E. LEVITON, *Assistant Curator (in charge)*
GEORGE S. MYERS, *Research Associate*
LAWRENCE SWAN, *Research Associate*

Horology
WILLIAM BARCLAY STEPHENS, *Honorary Curator*

Ichthyology
W. I. FOLLETT, *Curator*
LILLIAN DEMPSTER, *Assistant Curator*

Instrument Shop
ALVIN C. GUNDRED, *Superintendent*

Invertebrate Zoology
ROBERT C. MILLER, *Curator*
ALLYN G. SMITH, *Associate Curator*
FRANCIS P. FILICE, *Research Associate*
JOEL W. HEDGPETH, *Research Associate*
A. MYRA KEEN, *Research Associate*

Library
VERONICA J. SEXTON, *Librarian*
IGNATIUS MCGUIRE, *Associate Librarian*

Ornithology and Mammalogy
ROBERT T. ORR, *Curator*
ROBERT I. BOWMAN, *Research Associate*
ANATOLE S. LOUKASHKIN, *Research Associate*
DORCAS E. MACCLINTOCK, *Research Associate*
J. DAN WEBSTER, *Research Associate*

Pacific Discovery
DON GREAME KELLEY, *Editor*

Public Information
HAL RICHARDSON

Scientific Publications
EDWARD L. KESSEL, *Editor*

Student Section and Film Library
DOLLA C. WEAVER, *Supervisor*

Television
BENJAMIN P. DRAPER, *Executive Producer*
ERNEST R. ROOK, *Associate Producer*

* Owing to limitations of space, departmental assistants have not been included.
† On leave.

TO THE MEMBERS AND FRIENDS OF THE CALIFORNIA ACADEMY OF SCIENCES

The 108th year of the California Academy of Sciences was another year marked by devoted effort by everyone—Staff and Trustees alike—in carrying forward its scientific objectives and at the same time the previously reported program aimed at strengthening the Academy's financial position and broadening the base of its public and private support.

The Academy's work and its intrinsic value to society obtained broader recognition this year than ever before. A very bright spot was the largest numerical and percentage increase in membership in the entire history of the Academy, bringing the total membership to 2,937. In perspective—1861's 27% gain brings the two-year cumulative increase to over 50%—exactly 1,000 more members than in June of 1959. As an indication of community appreciation and response and support, this is a statistic of very particular importance—a good omen for the future.

Financially there also has been progress—but not enough. The operating deficit resulting primarily from the Museum activities was reduced from $98,252 in 1960 to $59,186 in 1961. A major part of this reduction was due to an increase in support of Museum activities by the City of San Francisco in the amount of $18,100.

For the third year, a special committee was formed under the chairmanship of Trustee Wilson Meyer to raise funds to meet the financial need created by this operating deficit. Corporations, foundations and friends responded generously in amounts larger than might normally be expected, in a similar manner as they had during the two previous years. Our thanks go to them for covering the major portion of the deficit, thereby making it possible to carry on the Academy's programs until a more permanent solution is achieved. This, however, is not a sound financial basis upon which to operate. Nor can we expect to receive "emergency" aid year after year. Some of the support we received is what that name implies.

Accordingly the trustees continued to focus their attention on our primary problem—that of restoring a sound financial base for the Academy and of eliminating the operating deficit. After thoughtful consideration, the Trustees drew up a statement outlining three alternate courses or solutions which were then discussed with the City administration. These alternatives are:

First, the City to accept full responsibility for the support of all public service activities and to provide the required monies by budget appropriation.

Second, to amend Charter Section 52 to allow the Academy to charge admission. In addition to amending Charter Section 52, it would be necessary to obtain court approval to allow charging admission to Steinhart Aquarium. Our counsel, after having studied this proposal, believes that this approval should be obtainable since in the present rebuilding of the Aquarium there will have, in fact, been built what is essentially a new aquarium, using only the remaining shell of the original Steinhart Aquarium.

Third, the remaining alternative is to balance our budget by a drastic reduction in public services. This would involve the closing of the public exhibit halls for a very substantial part of each week since lesser measures would not accomplish the required savings. In view of last year's attendance of over 2,500,000 people, this is not a thinkable alternative.

It is to be noted that it is the expressed policy and desire of the Trustees to provide for the operation of the Academy's scientific departments and other scientific activities out of income received from its endowment, its membership and other private sources. No monies for these purposes are being sought from the City.

These proposals and our problems have received most sympathetic consideration from the City administration. The Board of Supervisors responded in a very tangible manner by granting a further increase in budget appropriation of $30,000 towards support of public service activities for the coming fiscal year, 1961–62. For the long term we have been encouraged to seek relief by the second course, and on August 4th a formal request was presented to the Board of Supervisors to amend Charter Section 52 to permit charging admission. To assure the availability of the scientific knowledge accumulated in the Academy to all, it is the desire of the Trustees to provide free admission to school classes at all times, and to everyone during certain limited periods of each week.

I regret to report the death of Dr. William S. W. Kew, who served well since 1955 as a member of the Science Council and subsequently as a Trustee. To fill this vacancy, in July Mr. Francis Hutchens, whose advice and guidance as counsel have for many years been of great assistance to the Trustees, was elected to the Board.

As this is written, word comes of the death of Colonel George Stimmel, who became a member of the Board in 1955 and was elected treasurer in April 1961. Col. Stimmel had given unstintingly of his talent in analyzing and making more clearly understandable the complex financial accounts of the Academy.

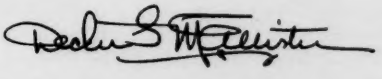
Since, out of modesty, it will not be included in his own report, it is a pleasure to record the honor accorded to Dr. Robert C. Miller, our Director, by his election to the presidency of the Academy Conference, the organization of 47 Academies of Science in the United States and Canada.

In conclusion, let me reassure you that substantial progress is being made, and it is with a feeling of appreciation that in behalf of the Trustees, I can in summary report:

- The biggest membership growth in the Academy's history
- with thanks, recognition of the Academy's public services by the City of San Francisco in the form of increasing financial support
- and last, but far from least, continuing substantial financial assistance from corporations and friends to tide the Academy over this difficult period.

These positive responses from all important sectors of the community will now encourage the Trustees and Staff to develop plans for a positive program of continuing growth and increasing contribution to the scientific and cultural values of the community.

Respectfully submitted,



San Francisco, California
September 6, 1961

REPORT OF THE DIRECTOR

The year ending June 30, 1961, has been a period of substantial growth and progress. Membership has increased, public attendance has increased, existing research programs have been expanded, new research programs have been initiated. In an era of unprecedented technological advancement, man still looks with undiminished curiosity to the future. With science occupying so much of human thinking, the Academy provides a wealth of information to the general public, provides a stimulus to youth to consider science as a career, and through its own research program advances the frontiers of knowledge.

MEMBERSHIP

Membership in the Academy increased during the year by 620 persons to an all-time high of 2,937. One important measure of the success of the Academy's program is the active interest and support of its members. As of June 30, 1961, there were the following numbers of members in the various categories:

Classification of Membership	*Number of Members*
Regular Members	1,573
Family Members	543
Contributing Members	84
Subscribing Members	10
Annual Sponsors	35
Life Members	223
Honorary Members	25
Fellows	218
Patrons	75
Benefactors	2
Associate Members	22
Special Observers	20
Corresponding Members	8
Student Members	99
TOTAL	2,937

ATTENDANCE

Interest in the Academy's program of education through public exhibits continued to grow, as indicated by an attendance that exceeded all previous records. The figures are:

North American Hall	534,458
Hall of Science	755,238
Steinhart Aquarium	1,354,876
TOTAL	2,644,572

This exceeds the previous year's total by a little more than forty-six thousand. Of the total attendance, 114,222 came in special groups, mostly school and college classes accompanied by their teachers.

BUILDING PROGRAM

A valued asset is a rare book room that was completed during the year. Funds were provided by the Lucie Stern Foundation, and the room will be known as the Lucie Stern Room. Of special construction to provide maximum safety and also humidity control, this room will give protection through the years to the Academy's oldest and rarest books.

Reconstruction of the Steinhart Aquarium under a $1,575,000 bond issue voted by the citizens of San Francisco has proceeded through the year, with such difficulties as might be anticipated trying to remodel a building that is full of both people and fish. There has been inconvenience to the public and staff, and no doubt to the contractor. The fish have not been heard from. Unfortunately the inconvenience promises to continue many months into the future before the work can be completed.

ACADEMY MASTER PLAN

During the year a Master Plan was drawn up by a committee appointed by the Trustees. The committee undertook to project the Academy's building needs twenty-five years into the future. The plan includes a Hall of Living Tropical Fishes to be underwritten by the San Francisco Aquarium Society. It also includes a Hall of Earth Sciences, a Hall of Man, and several other needed structures, none of which have been underwritten by anybody. Men of good will please note!

EDUCATIONAL ACTIVITIES

Exhibits

The Academy maintains an active program of changing exhibits, and from time to time makes additions to its permanent exhibits.

Among permanent exhibits, an African rhinoceros and a hippopotamus, gifts of Dean Witter, were installed in a newly constructed display case in Simson African Hall, against a striking background of reproductions of Neolithic rock-paintings from the Sahara.

A flower stand for the display of living wildflowers was installed in the Alice Eastwood Hall of Botany, a gift of the Marin Garden Club. A decorative bench, a gift of Mrs. Leslie L. Armstrong, was also installed in the Hall of Botany for the benefit of flower lovers who want to sit and contemplate.

Thirty-two temporary exhibits were installed during the year, a surprising accomplishment for our small exhibits staff. Visitors to the Academy are practically assured of seeing something new on every visit. In addition to other duties, the Department of Exhibits prepared an exhibit for the Tenth Pacific Science Congress in Honolulu, featuring the Academy's research in the Galapagos Islands; installed Academy-sponsored exhibits at the Marin Art and Garden Fair and at the Seventh Biennial Wilderness Conference; and performed miscellaneous services too numerous to mention.

Planetarium

The Morrison Planetarium continues to be a major educational attraction. It is one of the Academy's finest facilities for public instruction. Total attendance during the year is as follows:

No. of Shows	*Type of Show*	*Attendance*		
		Adults	*Children*	*Total*
768	Regular	65,473	35,916	101,389
171	Student	.....	54,769	54,769
939		65,473	90,685	156,158

While there was a small increase this year over last in regular show attendance, the increase for special student shows of nearly 1900 is notable. In fact, the May attendance of about 10,700 students topped all previous monthly records since the Planetarium opened. Further evidence of public interest in the Planetarium and the staff work associated with it has been the answering of more than 1000 written requests for information of an astronomical nature, the 2000 or more letters relating to student shows, together with uncounted thousands of telephone requests.

The Planetarium staff held nine monthly meetings of the Astronomy Section during the year, conducted courses in "Popular Astronomy" and "Celestial Navigation," handled six radio and TV appearances, gave 17 talks and lectures to clubs and other organizations, prepared a new Planetarium Booklet "Telescopes and Their Uses" (No. 11 of the series), besides writing several popular and scientific articles, adding new auxiliary equipment to the Planetarium

projector and its sound system, and cooperating with the Academy's research project on the celestial navigation of migratory birds, which depends on the Planetarium for some phases of this work.

Television

The Academy's popular "Science in Action" series completed its eleventh year on the air under the sponsorship of Wells Fargo Bank American Trust Company, with Benjamin Draper, Executive Producer, and Dr. Earl S. Herald, Curator of Steinhart Aquarium, as Program Host. In addition to Bay Area coverage on Station KRON (TV), 26 programs of the series were televised this year at Sacramento over Station KVIE, and the program was sponsored in Honolulu for the fourth year by the Hawaiian Telephone Company. "Science in Action" is now available to our armed forces overseas. The program continued to gather new honors this year including a third Ohio State Award and a Favorite Program award from the San Francisco *Examiner*.

Student Section

Our Student Section continues to grow and now numbers 99 members, each working on one or more scientific projects under a full-time Supervisor, Mrs. Dolla C. Weaver. It is now organized into departments, following the Academy set-up, issues "Student Discovery," a mimeographed publication, and published four "Student Occasional Papers" during the year by members working at an advanced level. Local field trips, together with several more extended trips were arranged this year using a new carryall for transportation. The Student Section is working diligently toward the Academy's objective of training junior scientists and providing the personnel and the facilities for their work. The response is gratifying, as pointed up this year by a grant to one student member from the American Association for the Advancement of Science for a special research study of the flora of the Tiburon Peninsula under the supervision of John Thomas Howell, the Academy's Curator of Botany.

Requests for Information

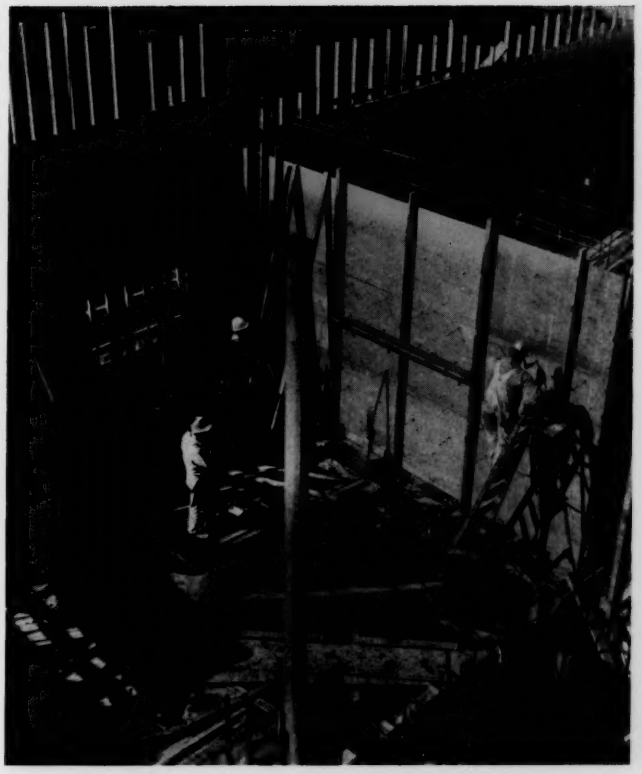
The Academy receives thousands of inquiries each year either personally, by letter or by telephone. Many are from students asking for information, help or advice on natural history subjects. We believe that all requests for scientific information should be answered in the best way possible. The Student Section Supervisor is now handling most of these inquiries. Those that require a reply from an expert are referred to research department staffs.

RESEARCH ACTIVITIES

Publications

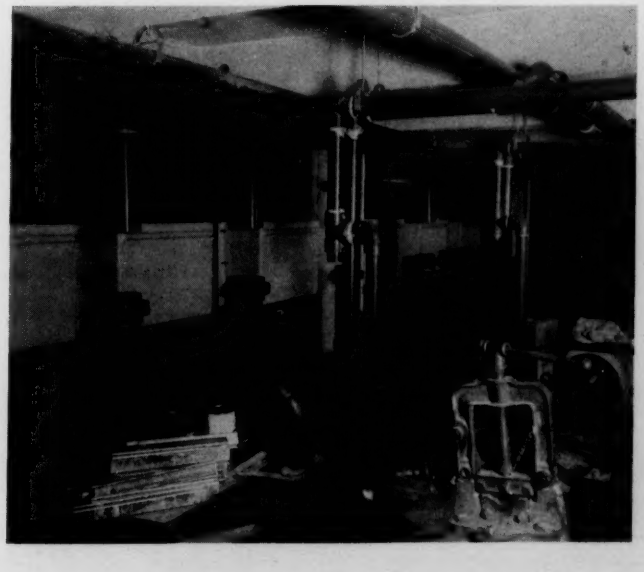
Results of scientific research appear in the Academy's Proceedings and Occasional Papers. During the year a total of eleven numbers of the Proceedings and four Occasional Papers were published. Copies are sent to about 800 domestic and foreign scientific institutions and libraries throughout the world in exchange for similar scientific publications.

Staff members of the Academy also have published articles in various scientific journals devoted to their specific fields of research. About 60 such articles, prepared individually or in collaboration with others by 25 staff members appeared during the year. Principal among this year's contributions is a 400-page college textbook *Vertebrate Biology* by Dr. Robert T. Orr, Curator of Birds and Mammals; a handsome volume *Living Fishes of the World* by Dr. Earl S. Herald, Curator of Steinhart Aquarium; and a section on the Amphineura (chitons and solenogastres) by Allyn G. Smith, Associate



The roof of the 100,000 gallon reservoir having been completed, the workmen on the Steinhart Aquarium rehabilitation start building the sidewalls of the garage which is situated overhead. The new porpoise tank is visible on the right.

A small portion of the 10 miles of plastic pipe used in the rehabilitation of Steinhart Aquarium. This section is in the new pumping plant.



Curator, Department of Invertebrate Zoology, contained in the *Treatise on Invertebrate Paleontology*, Part I, Mollusca, Vol. 1, published by the Geological Society of America.

Other Academy publications include the bi-monthly magazine *Pacific Discovery*, edited during the year by Don Greame Kelley, and the *Newsletter*, written by Hal Richardson, which is mailed monthly to members.

Color Printing Process

Work is continuing on the project of printing scientific illustrations in color under the direction of Dr. G Dallas Hanna. Although this work is still in the applied research stage, considerable improvement has been made during the year. Color plates appearing in recently published Academy Proceedings and Occasional Papers have resulted in many inquiries from scientific institutions and publications. Until staff rearrangements are made it will be necessary for the Academy, with some possible exceptions, to limit the production of color plates to its own publications.

Departmental Programs

Aquatic Biology

This department, under the direction of its Curator, Dr. Earl S. Herald, obviously has been severely hampered by the reconstruction of Steinhart Aquarium. In spite of this, with the accompanying need to close down part of the display tanks, over 180 new fishes, amphibians, and reptiles as well as numerous marine invertebrates were received and placed on exhibit. At the end of the year the Aquarium had on display over 3000 living animals, comprising nearly 300 separate species.

The Academy has a constant stream of visitors, many of whom were outstanding scientists, from all over the world every year; 1960–61 was no exception. Among the more prominent of these was His Royal Highness Akihito, Crown Prince of Japan, an accomplished ichthyologist, who visited the Aquarium in September while in San Francisco.

Biological research during the year by Robert P. Dempster, Associate Curator, included collecting data on sharks, bio-assay work on the toxicity of materials, and studying various diseases and parasites to which both fish and reptiles are subject.

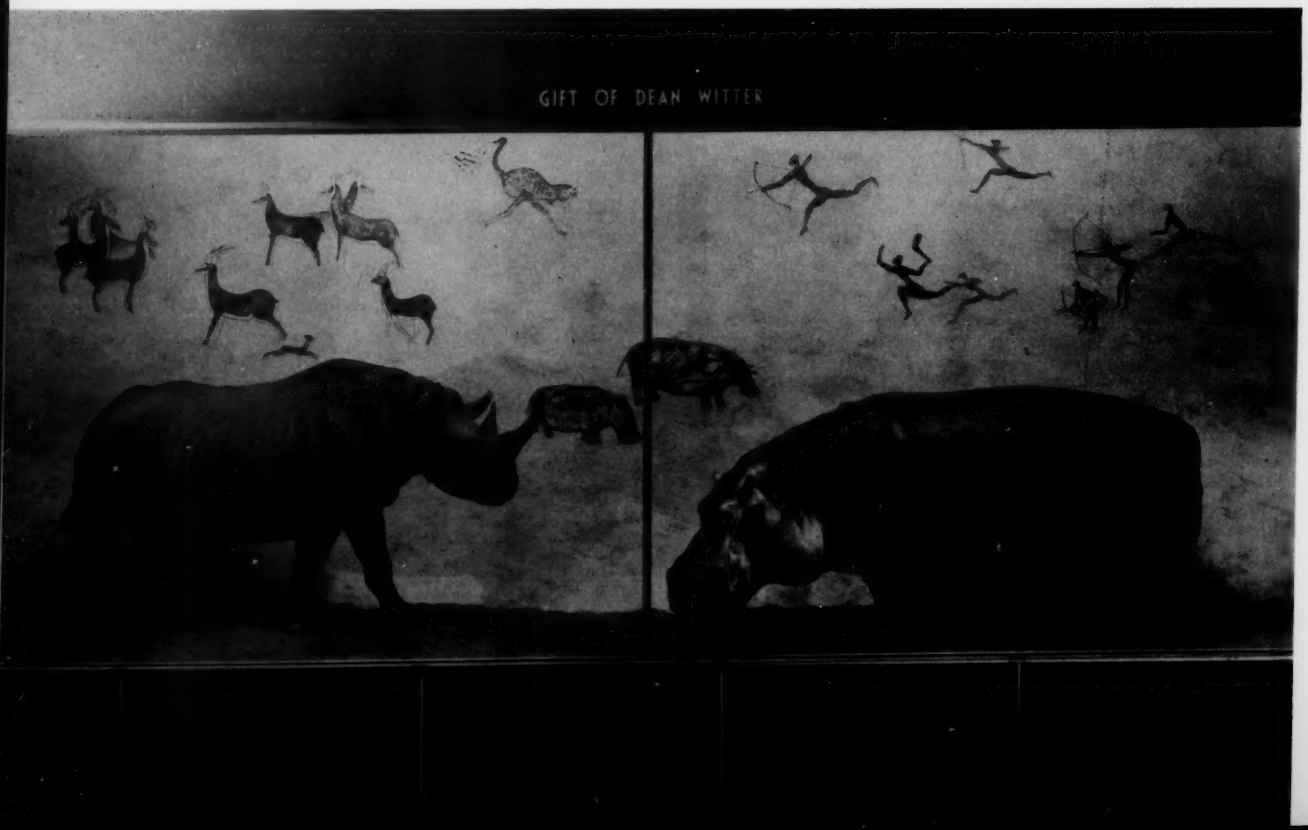
Astronomy

Planetarium activities have already been mentioned. To these should be added a research project, started this year by Assistant Curator O. Richard Norton, on the classification and analysis of meteorites; also the design and fabrication in the Academy's Instrument Shop of three Foucault Pendulums for other institutions, and the modification of a telescope for Contra Costa Junior College, under the direction of Curator George W. Bunton.

Botany

John Thomas Howell, Curator, reports the receipt of 12,594 accessions during the year. The number of mounted specimens in the herbarium now totals more than 425,000. New additions include important gifts and accessions from many sources. One of these consists of the Grace W. Hall collection of marine algae comprising 1200 named and mounted specimens. Another consists of more than 1400 specimens from Baja California collected during field expeditions sponsored by the Academy in cooperation with the Belvedere Scientific Fund. A third amounts to 2000 specimens from the Silveus Grass Herbarium, University of Texas, representing a fine addition to the department's already large and important collection of western grasses.

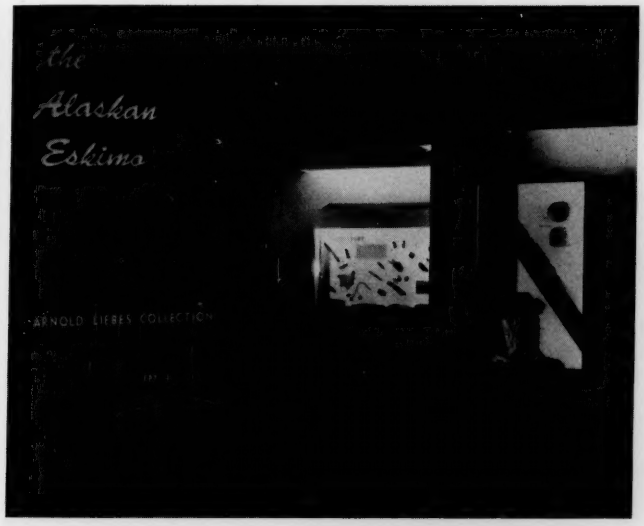
A gift of Dean Witter, the hippopotamus and rhinoceros exhibit with a background of Saharan rock paintings is the latest permanent addition to Simson African Hall.



Dr. Elizabeth McClintock, Associate Curator, among many other department duties, has continued her work on the project of compiling a list of the woody ornamental plants being sold in nurseries in California. This project is undertaken at the request of the State Department of Agriculture.

Entomology

This department, under the direction of Dr. Edward S. Ross, Curator, and Hugh B. Leech, Associate Curator, received nearly 139,000 new specimens during the year; 88,000 of these have been mounted and labeled. With the help of funds received from the National Science Foundation, a number of assistants have been added to this department's staff with the result that a dent of considerable



The gift of the Arnold Liebes Collection of Alaskan artifacts was a valuable addition to the Academy's ethnological collection and resulted in a highly popular temporary exhibit.

proportions has been made on the backlog of material from previous years. One hundred and fifty new cases for the storage of specimens were constructed, also with funds provided by the National Science Foundation.

Dr. Edward L. Kessel, Associate Curator, in addition to duties as the Academy's editor of technical publications, made many trips in his search for flat-footed flies (Platypezidae). Dr. C. Don MacNeill, Assistant Curator, worked on the Lepidoptera section of the department's collection, assisted Dr. Ross with the preparations for the latter's Asian Expedition, and still found time for research work on the Hesperiidae (butterflies commonly known as "skippers").

Geology

According to Dr. G Dallas Hanna, Curator, the largest and most important acquisition to the department during the year was the gift of a world-wide shell collection by Andrew Sorensen, of Pacific Grove, California. The department's collection of type specimens now numbers 12,362, with the addition of 264 during the year. Dr. Leo G. Hertlein, Associate Curator, continued work on his portion of a monograph on the fossil bivalves of the San Diego Pliocene formation. Mr. Charles W. Chesterman represented the Academy at the International Geological Congress in Copenhagen in August and continued the work of classifying and arranging the extensive Vonsen Collection of Minerals. Mr. Alan J. Galloway continued his work on the geology of the San Andreas Fault and prepared a guidebook dealing with the geology of the Point Reyes Peninsula to be issued by the American Association of Petroleum Geologists.

Herpetology

Dr. Alan E. Leviton, Assistant Curator in charge of reptiles and amphibians, reported the acquisition of 1,833 specimens, most of which were obtained by gift. Several important items of equipment were added during the year, including a stereoscopic microscope and certain instruments necessary for blood protein studies. Because of funds made available through the National Science Foundation, the services of Dr. Benjamin H. Banta were secured for curatorial and research assistance. The Assistant Curator attended a number of scientific meetings during the year and was elected a Fellow of the Academy of Zoology at Agra, India.

Ichthyology

This department added about 1400 specimens to its collection during 1960–61, including a number of rare species of fishes. W. I. Follett, Curator, in addition to making 32 collecting trips, attended a number of meetings of scientific societies and completed a term as President of the Society of Systematic Zoology. Research work on the collection was continued by the Curator and by Lillian Dempster, the Assistant Curator, on adding to the collection of color slides of various fishes as well as obtaining many radiographs with the department's X-ray equipment.

Invertebrate Zoology

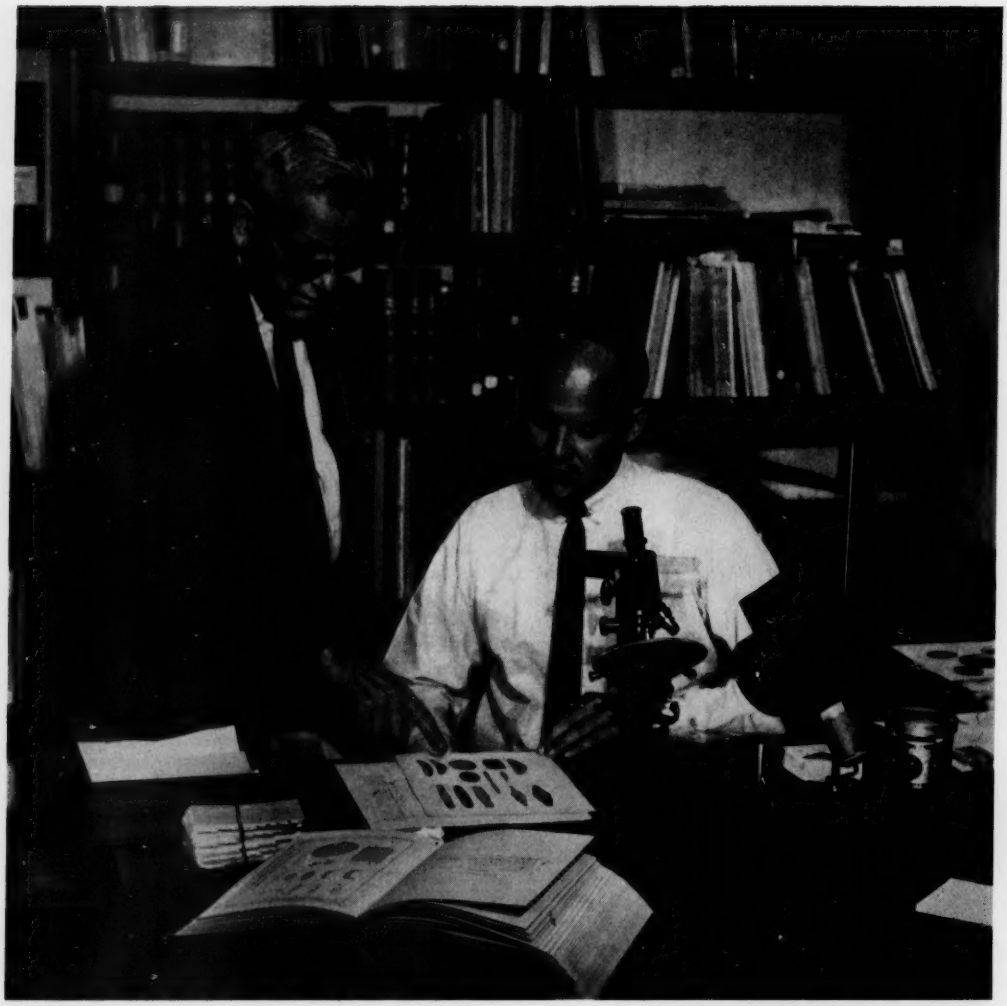
Since the Curator, Dr. Robert C. Miller, is primarily occupied with his responsibility as Director of the Academy, the work of this newest research department devolves principally upon Allyn G. Smith, the Associate Curator. The collection of preserved invertebrates consists of around 5000 jars containing approximately 50,000 specimens. Considerable progress was made during the year toward installing this collection in new glass containers with standard labels. The department has had some volunteer assistance on this work from a graduate student at San Francisco State College majoring in marine biology.

Ornithology and Mammalogy

Approximately six hundred and fifty specimens of birds and mammals were added to the department during the year. The most important collection was the result of field work carried on in the state of Morelos, Mexico, by J. Stuart Rowley. The Curator, Dr. Robert T. Orr, continued research on Mexican swifts as well as several other projects and began a population and behavioral study on seals and sea lions occurring along the central California coast. He attended a number of scientific meetings, including that of the American Ornithologists' Union at the University of Michigan in August and of the American Society of Mammalogists at the University of Illinois in June.

Field Expeditions

The Academy continued its Baja California research program this year, again with generous financial support from the Belvedere Scientific Fund. In August, and again in October, Academy members flew to La Paz in search of liv-



Walter W. Wornardt (right) working on a National Science Foundation Grant, under the direction of Dr. G Dallas Hanna (left), for the investigation of fossil diatoms of the late Tertiary of California.

ing examples of a curious bivalved-gastropod—a mollusk with a snail's body and a clam's shell. This trip proved to be highly successful with many living individuals found, representing a form new to science. In December another field party spent a week collecting marine organisms on Espíritu Santo Island and did some dredging. This party was joined by two marine biologists from the University of Mexico. Another field party spent three weeks in March and April in the region of the Vizcaino Desert, driving as far south as Punta Abreojos. Important collections of plants, reptiles and amphibians, land and fresh-water shells, and insects were made by this party, headed by Dr. Ira L. Wiggins.

Dr. Edward S. Ross, Curator of Entomology, with his son Clark, Dr. Paul Arnaud, David Renz and Mr. H. Vannoy Davis, made a field trip into northern Mexico in August, 1960, to collect embiids, or web spinners, and other insects. In June, 1961, Dr. Ross left for an extended expedition with a specially equipped vehicle of his own design for India, Pakistan, Ceylon and the Malay Peninsula, where he will continue his search for embiids. He is accompanied by Mrs. Ross, their son Clark, and David Cavagnaro.

Dr. G Dallas Hanna and Mr. Charles W. Chesterman of the Geology Department made two field trips into Modoc County during the year for the collection of minerals and fossils. In addition, Dr. and Mrs. Hanna spent a month in Alaska, including ten days on the Pribilof Islands collecting Pliocene and Recent mollusks. Drs. Leviton and Banta of the Herpetology Department were members of the Vizcaino Desert Expedition sponsored by the Belvedere Scientific Fund, as was Mr. Allyn G. Smith of the Department of Invertebrate Zoology. Dr. Robert C. Miller, the Director, collected marine invertebrates with the Espíritu Santo Island expedition in December.

Besides participating in major field trips and expeditions, members of the Academy's research staff undertake many local collecting trips for specimens relating to their specialties. For this they utilize week-ends and vacation periods. The Academy's collections are thus continually being augmented with valuable and needed material for research. As an example this year, one staff member added specimens of insects, beetles and land and fresh-water shells from the High Atlas Mountains of Morocco in North Africa.

Grants for Special Research Projects

The Academy has received eight new grants providing support for research work during 1961–62. These include the following:

Granting Agency	*Department*	*Purpose of Grant*
National Science Foundation	Entomology	Completion of a catalogue of Diptera of the family Tachinidae
National Geographic Society	"	Partial financing for Dr. Ross' Asian Expedition
National Science Foundation	Geology	Illustrations for a monograph on the marine Pliocene mollusks of San Diego County
National Science Foundation	Herpetology	Modernization of scientific collections and completion of research in progress
American Philosophical Society	"	Travel to eastern United States museums to study Philippine snakes
American Philosophical Society	"	Travel to eastern United States museums to study lizards of the Great Basin
Belvedere Scientific Fund	Academy and Stanford University	Preliminary investigations on the biota of Vizcaino Desert, Baja California
United States Air Force	Academy	Celestial navigation by migrating birds

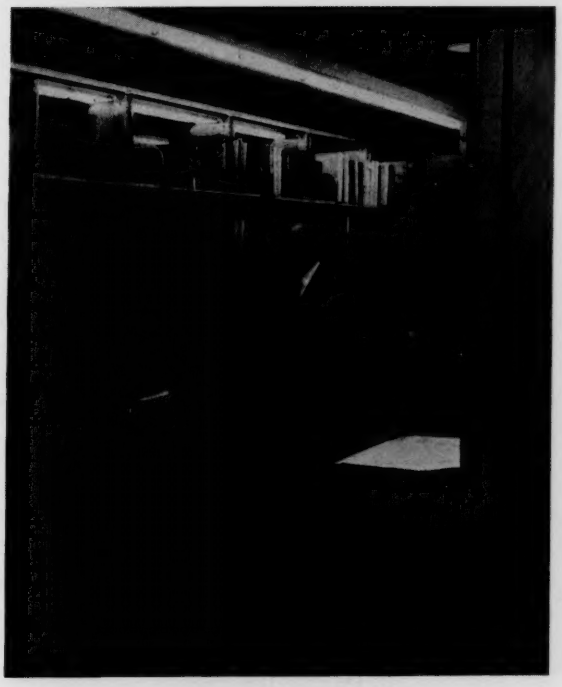
In connection with this last project, the grant was renewed this year because results have been of sufficient promise to warrant its continuation on an expanded basis. In consequence, Dr. Franz Sauer, who pioneered in the field of celestial navigation of birds and an eminent authority on European bird migration, has joined Dr. William J. Hamilton III on this work.

In addition to the above, several continuing grants from the National Science Foundation covered other research activities during the year. These include two grants to the Entomology Department for curatorial work and a modernization of facilities, support for Dr. Ross' studies of the Insect Order Embioptera (web spinners), and a grant to the Geology Department for a study of diatoms of the late Tertiary of California. Also, the State of California, through its Division of Fish and Game, continued its support of the Academy's Sardine Research Program involving behavioral studies.

These grants make it possible for the Academy to broaden its basic research program, and extend it into the field of behavior as well as in the areas of systematics and taxonomy.

LIBRARY

Under the direction of Miss Veronica J. Sexton, the Academy's J. W. Mailliard, Jr., Memorial Library, operating in beautifully designed new quarters, added over 14,000 items during the year. Included among these acquisitions from private donors, as well as by the judicious use of available funds, are photostatic copies of letters written in 1853 by Dr. Henry Gibbons, one of the Academy's founders; an early Canadian flora *Canadensium Plantarum*, by Jacques Philippe Cornut, published in Paris in 1635; a 23-volume work entitled, *Etudes de Lépidopterologie Comparee*, published in Rennes between 1904 and 1925 and not to be seen in any other West Coast library; and a 15-volume *Encyclopedia of Science and Technology*, a valuable reference work. Many other books, publications and scientific separates of great value to the Academy's research staff, as well as to other scientists, are also included in the list.



The Lucie Stern Room in the J. W. Mailliard, Jr. Library will be the depository for the Academy's rare books and manuscripts.

The special collection of Baja California literature received continued support from the Belvedere Scientific Fund. Among some forty items acquired were an early nineteenth century unsigned manuscript, *Experimentos, y Observaciones sobre las Serpientes en la California Hechas por el Padre Inamma Jesuita Aleman; Mappa Mondo o Vero Carta Generale del Globo Terrestre*, Naples, 1700; and the Spanish translation of Clavijero's *Historia de la Antiqua o Baja California*, translated from the Italian, by Nicolas Garcia San Vicente, Mexico, 1852.

Mention has already been made of the completion of the Lucie Stern Room, on the Library's mezzanine, for the storage and protection of rare books, maps and manuscripts. Several hundred volumes of considerable value have been placed in this room already, pending receipt of a collection of primary importance from the bequest of Edward E. Hills.

Apart from the Academy's staff members, the Library continued to serve other individuals, government agencies, business corporations and various institutions. Many items were on loan at the end of the year. Interlibrary loan requests are increasing, good evidence of the recognition of the Library's collection and its ability to further scientific research.

• • •

The growth and progress made this year by the Academy has been due entirely to the loyal and effective work performed by every member of the staff. The Director welcomes this opportunity to express appreciation, individually and collectively, for a good job done.

Robert C. Miller
Director

CALIFORNIA ACADEMY OF SCIENCES

STATEMENT OF INCOME AND EXPENSES FOR THE YEAR ENDED JUNE 30, 1961

INCOME:	
City and County of San Francisco for Operation of Steinhart Aquarium	$156,927.69
Less Aquarium expenses	156,927.69
Remainder	Nil
Endowment—Rentals from Commercial Building—net of $11,020.48 for depreciation, amortization of lease cost, and incidental expenses	98,971.52
Dues	25,696.00
City and County of San Francisco for support of Museum activities	74,908.53
Planetarium, less expenses of $69,131.77	7,894.78
Profit on sales of publications, booklets, postcards, and novelties, less costs of $31,340.45	25,170.48
Instrument shop, less expenses of $6,375.27	22,349.23
Vending machines	12,332.48
Television royalty	6,975.00
Donation	5,104.78
Miscellaneous	25,344.43
Total	304,747.23
EXPENSES:	
Scientific Departments	154,937.16
Museum and general	113,408.79
Administrative Salaries	32,037.00
Pacific Discovery, less income of $7,232.38	24,532.32
Interest	12,044.69
Other	26,972.97
Total	363,932.93
NET LOSS	$ 59,185.70

ACCOUNTANTS' OPINION

California Academy of Sciences:

We have examined the balance sheet of the California Academy of Sciences as of June 30, 1961 and the related statement of income and expenses for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances, except that it was not practicable to extend the examination of contributions beyond accounting for the receipts as recorded.

In our opinion, based on our examination, the accompanying balance sheet and statement of income and expenses present fairly the financial position of the Academy at June 30, 1961 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

HASKINS & SELLS

August 28, 1961

CALIFORNIA ACADEMY OF SCIENCES

BALANCE SHEET, JUNE 30, 1961

ASSETS		LIABILITIES	
GENERAL OPERATING FUND			
Cash	$ 16,855.72	Accounts payable (Note 2)	$ 390.00
Accounts receivable	11,082.64	Accrued interest on note payable of the capital fund	2,683.33
Inventory of books and postcards—At cost	10,067.58	Total	3,073.33
Unamortized portion of cost of acquiring lease on rental property (lease expires 1984)	15,922.50	General operating fund:	
		Balance, beginning of year	$ 50,855.11
		Transferred from special purpose funds	59,185.70
		Total	110,040.81
		Net loss for the year	59,185.70
		Balance, end of year	50,855.11
Total	$ 53,928.44	Total	$ 53,928.44
SPECIAL PURPOSE FUNDS (Restricted as to Use)			
Cash	$ 123,878.27	Special purpose funds:	
Security investments—At cost (quoted market value $284,264.91)	237,558.78	Research expeditions	$ 70,660.87
Accounts receivable	7,524.62	Entomology	67,802.75
Real estate (under sales option)	21,600.00	Botany	56,804.41
		Geology	31,771.84
		Astronomy	31,183.84
		Exhibition	24,181.84
		Construction	17,642.74
		Lectures	10,301.61
		All other	80,211.77
Total	$ 390,561.67	Total	$ 390,561.67
CAPITAL FUNDS			
Cash	$ 45,118.21	Note payable to Insurance Company, 5¾%—Due October 11, 1964, deed of trust given on rental property	$ 210,000.00
Security investments—At cost (quoted market value $163,919.88)	139,307.72	Capital funds	1,523,931.25
Rental property—net after depreciation of $503,930.71 (pledged as security for $210,000.00 note payable)	620,971.60		
Collections, library, and equipment	906,035.93		
Construction in progress	22,497.79		
Total	$1,733,931.25	Total	$1,733,931.25

NOTES:

1. Buildings located in Golden Gate Park carried on the books of the Academy at $2,341,206.44 are not shown above. Title to the buildings is vested in the City and County of San Francisco.
2. Telephone charges of $18,499.33 billed to the Academy by the Pacific Telephone & Telegraph Company have not been paid by the Academy and have not been reflected in the financial statements pending the result of a dispute between the telephone company and the City and County of San Francisco. It is not known at this time whether the Academy or the city will be liable if the charges are ultimately deemed proper.

GIFTS AND BEQUESTS

The activities of the California Academy of Sciences are supported to a substantial extent by gifts and bequests, or the income therefrom, received from friends who desire to stimulate science and education resulting from scientific endeavors. Such gifts and bequests are within the exemption provisions of Federal and State tax laws.

A bequest (contribution by will) may be made in the following form:

FORM OF BEQUEST

I give and bequeath to the California Academy of Sciences the sum of_____

dollars ($_____) to be applied to the use and benefit of the said Academy.

In case it is desired to specify the particular use to which the contribution is to be put, such use may be specified in place of the words "to be applied to the use and benefit of the said Academy" in the form given above.

In case it is desired to make the contribution to the Academy as a memorial, "In memory of_____" may be added to the form.

In all instances the gift should be to "California Academy of Sciences" in its full corporate name, even when specifying the particular use to which the gift or bequest is to be put.

Gifts and bequests for the Academy should be sent to the Treasurer, California Academy of Sciences, Golden Gate Park, San Francisco, California.

BARRETT G. HINDES
Treasurer